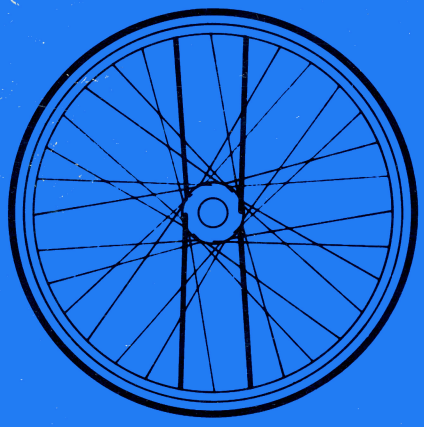
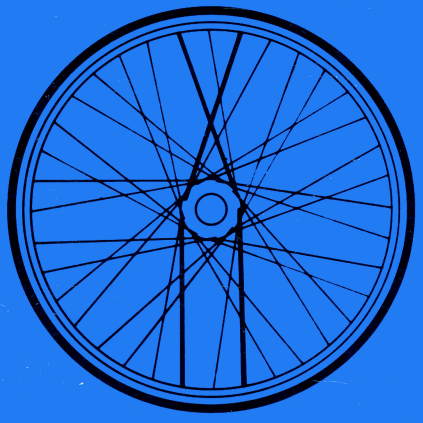


SUTHERLAND'S

HANDBOOK FOR BICYCLE MECHANICS



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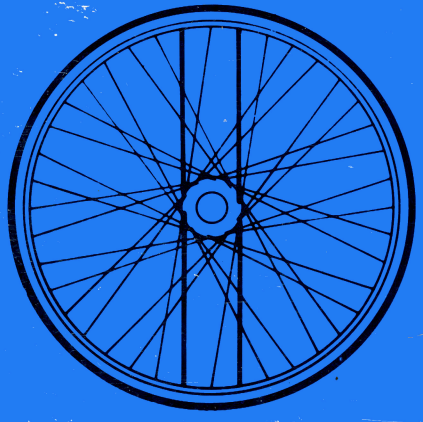
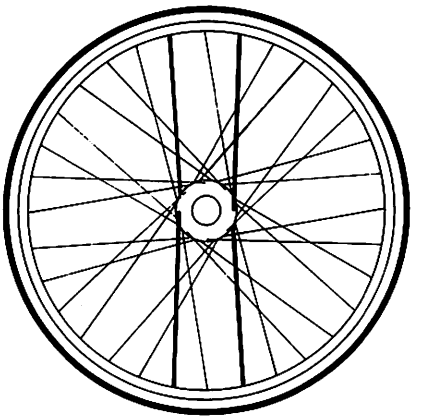
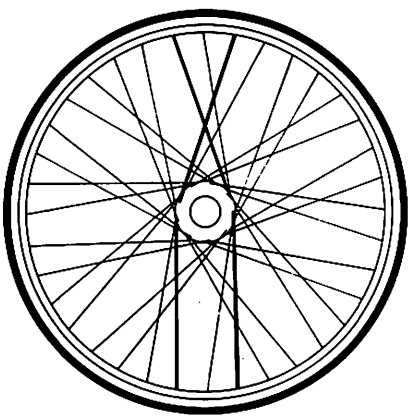




SUTHERLAND'S
HANDBOOK FOR BICYCLE MECHANICS

Third Edition

Howard Sutherland
John S. Allen
Ed Colaianni
John Porter Hart



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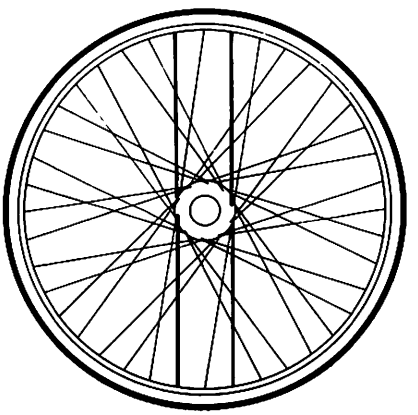
Drawings—Carlos Chavez, Mark Schroeder,
Carol Loverde, Tim Keenan
Berkeley, California 1980



With thanks to the following people and organizations:
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My Mother, Betsy Sutherland

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Jones Bicycle, Long Beach
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Schwinn Sales West
Safety Cycle Shop
Cycles Peugeot
West Coast Cycle Supply
Gitane Pacific
Lawee, Inc.
Linder Euro Imports
I. Martin Imports
Shimano Sales
H. McIver, Inc.
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INTRODUCTION

This is the third edition of Sutherland's Handbook for Bicycle Mechanics. It is a resource for people who work in the bicycle industry, and enthusiasts as well. The information contained in this handbook was gathered from many sources and involved considerable travel, measuring, and study to track down the details that make it valuable. Much of this data is available nowhere else.

We've gone to a lot of trouble to respond to your requests to create an extensive coaster brake and internal-gear hub section. Some of the hubs we've included have only regional distribution and some are obsolete. Because of this, no bike shop can or should stock all the parts we've listed. This almost all-inclusive section will be especially useful for training new help.

This third edition contains an expanded materials and tool section by Don Milberger of Bicycle Research. We also have much more complete tire chart and freewheel sprocket interchangeability charts. In addition, we have extensively updated and revised other sections to reflect the changing bicycle market.

Ed Colaianni contributed the disassembly and assembly procedures for the coaster brake and internal-gear hub section, as well as invaluable production help. His presence has made it a pleasure to get through the grind that it takes to produce a book like this.

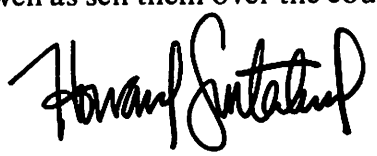
John Allen, who I originally met through his letters suggesting improvements to the first and second editions, compiled and designed the tire charts, trouble charts and the freewheel sprocket interchangeability charts. He also suggested many of the improvements incorporated in this edition.

Linne Gravestock deserves a medal for her support.

When I was working on the first edition, many people complained about the lack of standards for bicycle parts. This is still a frustrating and time-consuming problem although progress has been made. While I was working on this edition, the groundswell of complaints was aimed at parts manufacturers who were willing to flood the market with inadequately-designed and -tested parts. Carrying the inventory to service these parts has become impossible at the shop level, as well as at the distributor levels. Service has suffered. As usual it is the shops who must bear the brunt of the complaints. I would like to see an awareness by parts manufacturers of the problems they are creating at the shop level. I am convinced that shops are the backbone of the bicycle industry and everything possible must be done to help make them viable.

In the first edition, prepaid coupons were included to make it easier for readers to make suggestions and comments. I tried to incorporate as many suggestions as I could, and I certainly appreciate all the ideas I received. In this edition, I am again including prepaid coupons, and I look forward to hearing from anyone with suggestions for improving this Handbook. Questions and comments are always welcome.

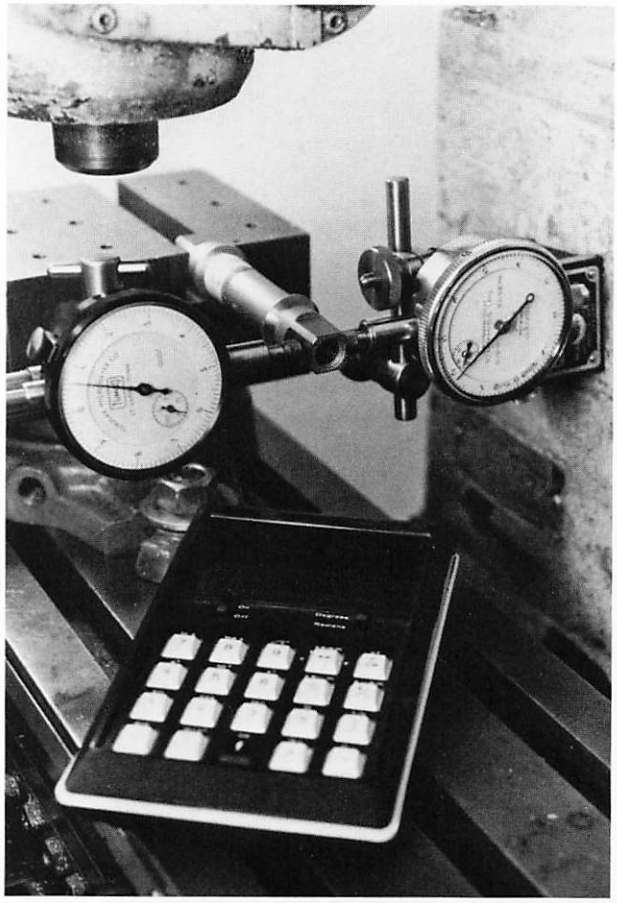
Take some time to thumb through this book and get familiar with what is covered. I know you will find it useful. I suggest you buy one for each mechanic, one for your order desk and one for the front counter, as well as sell them over the counter. You will probably be referring to them often.



December, 1980

Love, work and knowledge are the well-springs of our life. They should also govern it.

Wilhelm Reich



"One measurement is worth a thousand expert opinions."

—anonymous

The Friend

There are lots and lots of people who are always asking things,
Like Dates and Pounds-and-ounces and the names of funny Kings,
And the answer's either Sixpence or A Hundred Inches Long.
And I know they'll think me silly if I get the answer wrong.

So Pooh and I go whispering, and Pooh looks very bright,
And says, "Well, I say sixpence, but I don't suppose I'm right."
And then it doesn't matter what the answer ought to be,
'Cos if he's right, I'm Right, and if he's wrong, it isn't Me.

—A. A. Milne

CORRECTIONS—THIRD EDITION

Page 0-6 *Countries of origin for these brands should be as follows:

RIH	Netherlands	Rollfast	USA
Raleigh	England	Rossignoli	Italy
Rapido	Czechoslovakia	Ross	USA
Rickert	Germany	Royal Enfield	England
Robin Hood	England	Royce Union	Japan

Page 2-6 *Remove comma between EX and MD in Shimano 600 EX MD (Bolt circle diameter 110).

Page 3-16 Under 2° Series Type I move 3U-B up to same line as 68-T.

Page 3-17 5SS (Type II column) and 5S-B should be on the same line. They have identical values in columns A, B, C and D.

Add a footnote to 5SB (Type II column) and 5S-B (Type I column) warning that these axles are not interchangeable.

Page 4-14 In the sixth sprocket position New Winner NW-7000 7-speed ultra and New Winner NW-6500 6-speed ultra sprockets are not interchangeable. Add a horizontal line to make two boxes out of one.

Page 4-15 Between sprocket positions 5 and 6 on the New Winner NW-6500 6-speed ultra there is no sprocket spacer. Make a box by drawing a vertical line and write "none" in it.

Page 4-16 Note C at the bottom of the page. Last sentence should read "To remove #1, loosen the others, lock #3 and #4 together (like cone and locknut) and loosen #1.

Page 6-3 3-lugged sprockets HSL 713, HSL 714 and HSL 715 should be followed by [3]. They are available flat only.

Gear ratios for F&S 2-speed should be 1.00 and 1.36 in gears 1 and 2 respectively.

Page 7-12 Topmost paragraph of ASSEMBLY Step 2 should read:

> With brake shoes in place as shown, position hub shell *straight-sided opening down* and slip over assembly.

Page 7-21 Item 12 (Hub shells, 3 lines): draw a vertical line between SC-1 and SC columns. These hub shells are not interchangeable.

Page 8-13 Footnote #6: correct page reference to page 8-16.

* Corrections marked with an asterisk have been included in the second printing. The second printing will say "Second Printing" above the Library of Congress Card Number on the back of the title page.

CORRECTIONS—THIRD EDITION (cont.)

Page 9-10	Assembly Step #4: Add the following sentence to the end: Be sure spring is tensioned enough to hold sliding key B in place. Replace the spring if it is too weak.
	Assembly Step #5: Second paragraph first line should read: Lift hub shell about ½" (12mm) and tighten axle
Page 10-8	3SC (upper drawing) right-hand cone (labeled 56) should be unlabeled. It is interchangeable with the cone of the normal 3-speed hub.
Page 12-7	The numbers in parenthesis below **700 C, 28 × 1⅝ × 1⅜** should read **(20-622 thru 38-622)** not **(23-622 thru 32-630).**
	Add 28 × ½ Raleigh Tourist —2
Page 12-9	The numbers in parenthesis following **26 × 2.125** should be **(54-559).**
Page 12-10	58mm hub: add 257 for 24 spokes, 2X.
Page 12-12	34mm hub with 24 spokes 2X should be 218 not 214.
Page 12-13	The second group of rims (Araya and Schwinn S-7) should be headed **20 × 1¾ (47-419)** not **20 × 1⅜ (47-419).**
Page 12-16	MAXICAR TANDAM HUBS 27": Move 4X and 3X one column to the right putting 4X under "no." and 3X under "crosses."
Pages 12-24 thru 12-29	Add S-2 to the Schwinn Rim column in the following lines: next to **26 × 2.125** (page 12-25), **24 × 2.125** (page 12-26), **20 × 2.125** (page 12-27) and **16 × 2.125** (page 12-28).
Page 12-27	20 × 1.75 brake radius is 203 (not 228) and tire outside radius is **244-253** (not **270-279**).
Page 12-29	11 × 1¾ Rim outside diameter is 237 (not 229).

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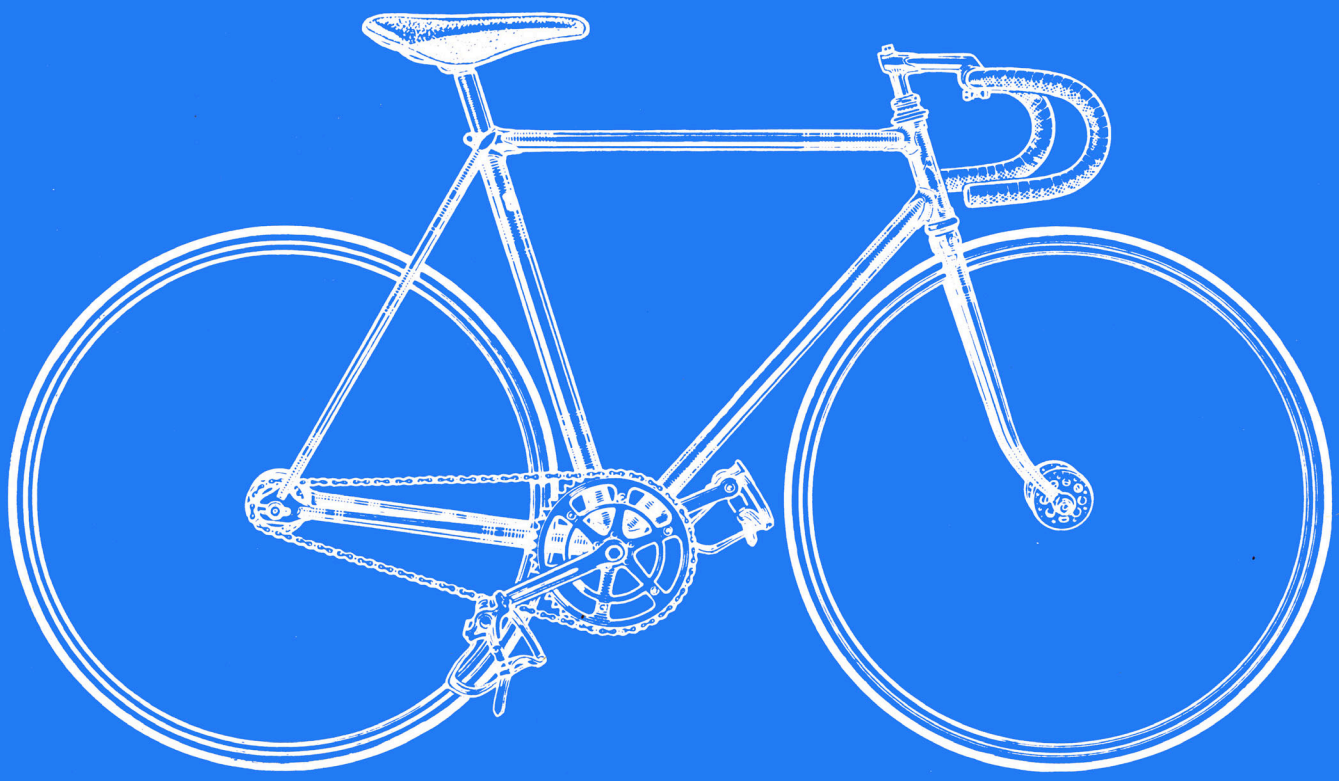

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HOW TO USE THIS BOOK

SYMBOLS

These symbols will be used to help you find the information you are looking for.

BALL SIZES

THREAD SIZES

Things to watch for; helpful information

ID The easiest way to identify a part

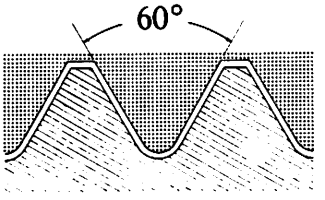
CLASS OF FIT

This system of grading will be used to help you choose the right combination of parts for a job. Because of shortages of parts and a lack of international standards it may be necessary to use a part that doesn't quite fit properly. Hopefully this "make do" style of bicycle repair won't be necessary in the future.

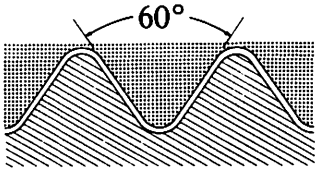
Class A	Made to fit
Class B	Will fit and be serviceable but slight damage to the parts may result.
Class C	Looks like it might work but won't.

THREAD STANDARDS

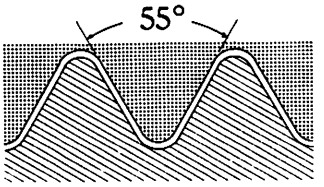
Metric Standard



British Standard,
B.S.C.,
American Standard



Italian Standard,
Whitworth Standard



HOW TO USE THIS BOOK

THREAD MEASURING

EXAMPLE: 9/16"x 20 TPI

The first number refers to the nominal diameter of the male part. When actually measured as in figure A, it is frequently slightly undersize. The second number refers to the number of threads per inch (TPI) or the number of millimeters per thread as measured in Figure B with a thread pitch gauge. Threads must be clean when measuring. Any rocking motion back and forth indicates an incorrect match.

These numbers do not give you any information about the standard used in cutting the threads and this is where some confusion arises.

For instance Italian headsets and English headsets would seem to be interchangeable with a class A fit.

Italian headset threads 25.4mmx24 TPI
English headset threads 1"x24 TPI

Since 25.4mm = 1 inch it would seem they were the same. However, you will notice by comparing the Italian and the English standard for cutting threads that the angle of the threads is different. There may be a mismatch, although slight, to an English fork fitted with an Italian headset or an Italian fork fitted with an English headset. For this reason it should be considered a Class B fit.

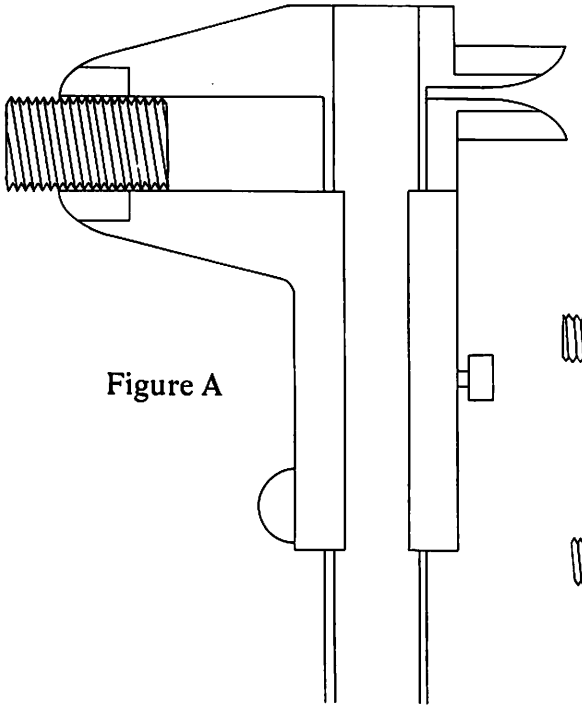


Figure A

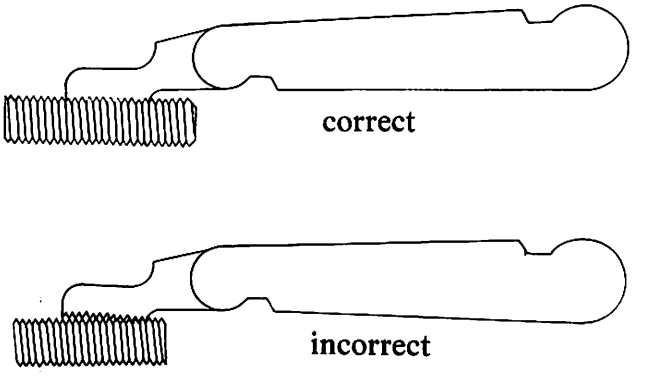


Figure B

HOW TO USE THIS BOOK

NATIONALITY OF PARTS

Parts will be listed as English, French, Italian, Swiss or U.S.A. to show the standard used in cutting the thread or the size of the part. Manufacturers, however, do not always use their national standard and different sizes are used instead. For this reason Raleigh and Schwinn will be listed separately. Other exceptions do exist and will be noted when possible.

Country of Origin does not necessarily indicate the national standard for a part. For instance, French bicycles exported to the U.S.A. on a large scale use English freewheel threads.

COUNTRY	STANDARD USED
Australia	English
Austria	English
Belgium	English, some French
Canada	English
Denmark	English
England	English*
Finland	English
France	French
Germany	English
India	English
Italy	Italian
Japan	English, U.S.A.**
Mexico	Italian
Netherlands	English
Norway	English
Raleigh	English unless listed separately
Schwinn	English unless listed separately
Spain	French
Sweden	English
Switzerland	French unless listed separately
United States	U.S.A., English

*Please note exceptions under Bottom Bracket and Headset
**Japanese bikes imported to the United States are either U.S.A. standard or English Standard. Generally, if it has an Ashtabula (one piece) crank it is U.S.A. standard; if it has a 3-piece crank it is English Standard.

➔ HOW TO USE THIS BOOK

BICYCLES—PARTIAL LIST

AMF	USA
Alan	Italy
Allegro	Switzerland
American Eagle	Japan
Atala	Italy
Atalantica	Italy
Austro Daimler	Austria
Azuki	Taiwan, Japan
Batavus	Netherlands
Beacon	France, USA, Japan
Benotto	Italy via Panama
Bertin	France
Bevilacqua	Italy
Bianchi	Italy
Bottecchia	Italy
Branca	Italy
Bridgestone	Japan
Ellis Briggs	England
Burtin	Switzerland
Claude Butler	England
Geoffrey Butler	England
CCM	Canada
CNC	France
Caloi	Brazil
Camera	Italy
Cavaliri-Milani	Italy
Cazenave	France
Centurion	Japan
Chaplait	France
Cherry	Japan
Chiorda	Italy
Cilo	Switzerland
Cinelli	Italy
Cinzia	France
Colnago	Italy
Columbia	USA
Condor	England
Coventry Eagle	England
Crescent	Sweden
DBS	Norway
Dawes	England
de Gribaldy	France
Delcroix	France
De Rosa	Italy
Al Drysdale	USA
Ducheron	France
Eisentraut	USA
Eroba	Netherlands
F.W. Evans	England
Fabo	Italy
Falcon	England
Favorit	Czechoslovakia
Ferrare	Japan
Flandria	Belgium, Portugal
Follis	France
H. France	Argentina
Frejus	Italy
Fuji	Japan
Galmozzi	Italy
G. Genet	France
Gios	Italy
Gitane	France
Grandis	Italy
F.H. Grubb	England
Guerciotti	Italy
Rene Herse	France
Hetchins	England
Hurlow	England
Ideor	Italy
Itoh	Japan
Iverson	USA
JRJ	England
Bob Jackson	England
Jawa	Czechoslovakia
Jeunet	France
Juvela	Switzerland
Kabuki	Japan
Kobe	Japan
La France	France
La Parisienne	France
La Piere	France
Lambert	England
Lejeune	France

BICYCLES-PARTIAL LIST (cont.)

Legnano	Italy
Liberia	France
Limited	USA
Lucifer	Switzerland
Lupo	Italy
Lygie (Ligie)	Italy
MKM	England
Magneet	Netherlands
Main D'or	Belgium
Maino	Italy
Maserati	Italy
Masi (Alberto)	Italy
Masi (Faliero)	USA
Meral	France
Mercian	England
Mercier	France
Eddy Merckx	Italy, Belgium, England, Switzerland
Robert Meyers	USA
Miyata	Japan
Monarch	USA, Sweden
Mondia	Switzerland
Mondu	Germany
Mossberg	USA
Motobecane	France
Murray	USA
Nishiki	Japan
Olmo	Italy
Paletti	Italy
Panasonic	Japan
Paris Sport	France
Peugeot	France
Plum Vainqueur	Belgium
Pogliaghi	Italy
Harry Powers	USA
Presto	Holland
Puch	Austria
RIH	Netherlands
Raleigh	England
Rapido	Czechoslovakia
Rickert	Germany
Robin Hood	England
Rollfast	USA
Rossignoli	Italy
Ross	USA
Royal Enfield	England
Royce Union	Japan
Samurai	Japan
Schauff	Germany
Schroeder	Denmark
Schwartz	Switzerland
Schwinn	USA
Sekai	Japan, Taiwan
Sentinel	USA
Alan Shorter	USA, Japan
Singele	Italy
A. Singer	France
Starnord	France
George Stratton	England
A.D. Stump	USA
Suchia	Japan
Superia	Belgium
Sutter	France
Takara	Japan
Jack Taylor	England
Terrot	France
Torpado	Italy
Triumph	England
Umberto Dei	Italy
Unic Sport	Belgium
Unikap	Netherlands
Univega	Japan, Taiwan, Italy
Urago	France
Vaiaqueur	W. Germany
Velosolex	France
Vetus	USA
Vita Sprint	France
Viking	England
Viscount	England
Vista	USA
Windsor	Mexico
Woodrup	England
Zeus	Spain

MATERIALS

Working on bicycles requires some basic knowledge of metals and their characteristics. Contrary to the current use of the word in the bicycle trade, alloy does not mean aluminum but rather indicates a mixture of metals. An alloy is generally a base metal such as steel or aluminum with relatively small percentages of alloying metals which impart desired characteristics to the base metal. These include strength, hardness, wear resistance, machineability, corrosion resistance, and others. The characteristics of a metal can be changed further by heat treating and/or work hardening.

ALUMINUM

Pure aluminum is a soft, weak metal with very good corrosion resistance. To be used for bicycle parts it is alloyed with other metals to increase its strength and make it heat treatable. As this alloying degrades the corrosion resistance, most aluminum parts are anodized to protect against corrosion. Generally this coating is clear, although black and other colors are finding their way into bicycles.

STEEL

The most common steel used on bicycles is carbon steel which ranges in carbon content from a few tenths of a percent in some frame tubes to about one percent in springs. Generally, the higher the carbon content the stronger the steel. By adding small amounts of other metals such as chromium, molybdenum, manganese, etc. much stronger steel can be produced. These alloys are generally found in higher quality frame tubes.

Heat Treating

Most steel can be hardened by a variation of two general techniques: tempering and case hardening.

High carbon steel and many steel and aluminum alloys may be tempered. In this process, the material is heated to a specific temperature and then quenched to harden it. The parts are held at another lower temperature for an appropriate length of time to lower the internal stresses and draw back the hardness to the desired point. This leaves the part uniformly hard throughout. Case hardening can be used on low carbon steel which generally cannot be tempered by the process of heat treating. Case hardening loads the surface of the part with a material, usually carbon, which will allow the surface to become quite hard while leaving the core unhardened. This is desirable to give a hard wearing surface and a non-brittle body. Case hardening also involves heating and quenching.

MATERIALS (cont.)

Work Hardening

Another method of hardening, sometimes unintentional, is by work hardening. Bending, pounding or manipulating the metal causes it to harden. This can be demonstrated by putting a sharp bend in a piece of wire and attempting to straighten this bend. The bent part obviously has hardened and will not straighten to its original form. This characteristic makes it difficult to properly straighten a bent fork blade because the bent section is now harder than the unbent section.

Annealing

Annealing is the process of softening metal by heating and slowly cooling.

CUTTING OPERATIONS

TOOL STEEL

Cutting tools that are intended to cut steel are made of a special class of steel called tool steel. Tool steels may be either high carbon or alloy steel. Alloy tool steels are generally called high speed steel as they retain their edges at the temperatures generated by high speed cutting. Carbon steel tools are less expensive than high speed steel and are generally quite adequate for thread cutting, reaming and milling when the job is done by hand. The greater cost of high speed steel is justified by increased durability when driven by a power tool. Drill bits for cutting steel should always be high speed, as they will surely be used with a power drill. Regardless of the material used, all metal cutting tools have delicate, brittle cutting edges which are easily damaged by misuse. Many more cutting tools are broken than worn out. Do not throw them together in a box or drawer.

LUBRICATION AND COOLING

When using cutting tools, both the tool and the piece to be cut must be properly lubricated and cooled with cutting oil. Most metal cutting done on bicycles is in steel or aluminum. For best results in steel, use a high sulfur base cutting oil available from hardware stores. It is also adequate for aluminum. Motor oil, bicycle oil, WD 40, or some of yesterday's coffee will *not* do in a pinch! You will dull your tools and do an inferior job unless you use the right cutting oil in the right quantity. Dabbing a little oil somewhere on the tool or work before cutting is a waste of time. The heat and friction are at the cutting edges. Keep them *flooded* with cutting oil throughout the operation.

HOW TO USE THIS BOOK

CUTTING OPERATIONS (cont.)

SHARPENING

Even under the best of conditions cutting tools get dull. Mechanics throw razor blades away after a few shaves, but expect a tap to cut steel forever. It will, of course, but only if you get it resharpened before it gets so dull that it breaks off in a hole. Quality drills, taps, dies, mills, reamers, etc. can all be resharpened at a fraction of their replacement cost! When the tools don't seem to cut as cleanly and effortlessly as they did when new, look in the Yellow Pages under "Grinding—Precision and Production". Most large cities will have at least one shop that can do this type of work.

DRILLING

Probably the most common metal cutting operation is drilling. Like other power cutting operations it requires eye protection and lubrication. The two lips on the end of the drill do all of the cutting and should be kept flooded with cutting oil. The point between these lips is a small chisel which does not have a sharp edge and must be forced into the work. When drilling larger diameter holes you will find it much faster and easier to drill a pilot hole equal in size to the chisel edge on the larger drill. All drills, even when properly sharpened, make a hole larger than the drill bit by a few percent. Improperly sharpened, this error may become quite large and the hole may not be round. Drilling with a dull bit causes overheating of the work, the bit, the motor, and the operator. The undue friction can cause the walls of the hole to become work hardened, which may lead to tap breakage if you attempt to thread the hole.

THREAD CUTTING

It is important that the hole or shaft size be appropriate for the tap or die being used. (For tap drill sizes for common fasteners see Appendix page 16-4). If the tool is required to remove too much material, it will bind and possibly break. If too little material is removed, the thread will not be strong enough. In practice, the thread profile is never as sharp as the drawing on page 0-2. The strength of a thread is not improved significantly by exceeding 60% of the theoretical thread height pictured in the drawing.

Since all the cutting is done by the first few threads of the tap or die, these edges must be flooded with cutting oil during the threading operation. Failure to adequately lubricate these edges will result in rapid dulling of the tool and torn and ragged threads in the work.

CUTTING OPERATIONS (cont.)

When threading, the tool should be reversed periodically to break the chip which is formed by the cutting edge. When threading a deep, small diameter hole such as the rear axle adjuster in a dropout, the tap should be backed out completely and chips removed from the tool to prevent binding and breaking. When cutting large diameter fine pitch threads such as bottom brackets and steer tubes, the cutting tool must be accurately aligned with the work. A die stock with an accurate guide must be used on steer tubes and a piloted double tap set must be used on bottom brackets to assure proper alignment of the bearing races and minimize tool wear or breakage. It is important to use the proper tap handle or die stock and rotate evenly with both hands to prevent side thrust which may result in broken tools and ruined work.

THREAD CHASING

Thread chasing is distinct from tapping in that it is not cutting threads, but is reforming damaged threads. Taps and dies designed for cutting threads may be used for this purpose as well as cheaper tools that are adequate only for chasing. While it may seem to be a much easier job, use care and flood with cutting oil as in thread cutting. Most bottom bracket "thread chasers" have little or no pilot, making it difficult to align the tool with the hole. When chasing right hand threaded bottom bracket threads with a pilotless tap, use a lockring threaded onto the tool to help judge straightness.

MILLING (FACING) & REAMING

The ends of the head tube and bottom bracket must be accurately cut so that they are parallel. Facing assures alignment of the bearing races and freedom from binding. The head tube must also be reamed so that the pressed bearing races will fit into the head tube properly. Facing and reaming operations are done with special cutters made for the job. As with other cutting operations the tools must be sharp and well flooded with the proper cutting oil. Generally, the face of the tube should be milled until the tool is cutting all the way around the hole.

GRINDING

Grinding may be used on any steel. It must be used on hardened steel, as normal cutting tools will not work. Grinding is a hazardous operation, requiring guards, eye protection, and proper technique. Grinding wheels must be sharpened and formed with a "wheel dresser" to give good results. Do *not* attempt to grind non-ferrous metals such as aluminum or brass! Use a file or power sander for these soft metals as they will clog the pores of the grinding wheel.

CUTTING OPERATIONS (cont.)

FILING AND SAWING

These methods of metal cutting have much in common: They are generally done without lubrication. Always use top quality files and saw blades; their increased life makes them well worth the purchase price. Select the proper grade or teeth per inch for the material to be cut. Use fine teeth close together for steel or thin material. Use larger teeth further apart for aluminum or thick material. At least two teeth should be in contact with the work at all times. Cut away from your body using a smooth slow stroke. Release pressure on the back stroke to protect the edges of the teeth. Files should be cleared of chips after a few strokes to prevent clogging, which affects speed of cutting and the quality of the job.

FITS AND TOLERANCES

Parts that are made to be assembled together must be designed to fit each other. The desired degree of tightness of the fit and the size of the parts determine the *tolerance* or amount of variation permitted on dimensions or surfaces of the parts. On threaded parts the pitch of the threads and the length of engagement must also be considered.

Unfortunately, poor quality control in manufacturing can alter the results of even the best designs. Many of the "interchangeable" bicycle parts are so poorly made that to get a good fit several "identical" parts must be tried. This shortcoming applies to some of the best known and most expensive components in the industry. Measuring a sample of bottom bracket components showed that several of the major Japanese manufacturers hold very good tolerances, but they are the exception. It is fortunate that bicycles are forgiving machines due to their simplicity, flexibility, and light loading. As bicycles become more important as vehicles for basic transportation, let us hope quality control improves.

HOW TO USE THIS BOOK

BEARINGS

BEARING DESIGN

Bearings are used to minimize friction and heating where various parts rub against each other. The type of bearing used almost exclusively in bicycles is the ball bearing; it is very efficient, easy to fit, and inexpensive. Ball bearings fall into three general classifications which dictate their design and application: *radial bearings* which are designed to be loaded at right angles to the axis of the shaft, *thrust bearings* which are designed to be loaded on the axis of the shaft, and a combined *radial and thrust bearing* which will accept some loading on both axes. The separate cup, cone and ball arrangement used on most bicycles is of the radial/thrust type. The major load on bicycle bearings is radial, except for the high thrust load on the headset lower bearing.

Bicycle bearings are lightly loaded and rotate slowly. This allows the use of inexpensive, rather crude bearing surfaces. Except in very expensive components these surfaces are stamped or machined rather than ground true to a fine finish. Grinding would add more to the cost than the minimal decrease in friction can justify.

Cartridge or sealed bearings are finding their way into quality bicycle components. These bearings, commonly used in industrial applications have the balls captured between inner and outer races making up a one-piece unit. (In a normal bicycle bearing the cups and cones are the races.) These cartridge bearings are very precisely made and may include felt or plastic seals to hold in grease and keep out dirt and water. While this type of bearing is vastly superior, it lacks one important virtue that the cup/cone type bearing does have: it will not tolerate nearly as much misalignment as the cup/cone bearing can (and must). The thin flexible axle and the narrow spool of a standard bicycle hub cannot hold cartridge bearings in alignment. A larger diameter spool is required to keep the *outer* races aligned as the rider imposes both radial and thrust loads on the hub flanges. Similarly, the axle inside the hub must be larger in diameter to keep the *inner* races precisely lined up. Good design can accomplish this without a weight penalty.

HOW TO USE THIS BOOK

BEARING MOUNTINGS

A bearing is no better than its mounting.

The smoothness, efficiency, and longevity of bicycle bearings can usually be improved by refining the mountings found on the average bicycle frame. For general instructions on reaming, tapping and milling, see section on cutting operations, above. Procedures for specific bearings follow.

Hubs

The rear drop-outs and the fork ends are an important part of the wheel bearing mounting. If the hub is clamped between non-parallel surfaces, the thin axle will bend and mis-align the cones. Fork end alignment gauges are made by Campagnolo, Park and VAR to check and correct the alignment and spacing of fork ends. (See Figures 1, 2 and 3.) These tools are a combination gauge and lever for bending the fork ends into alignment.

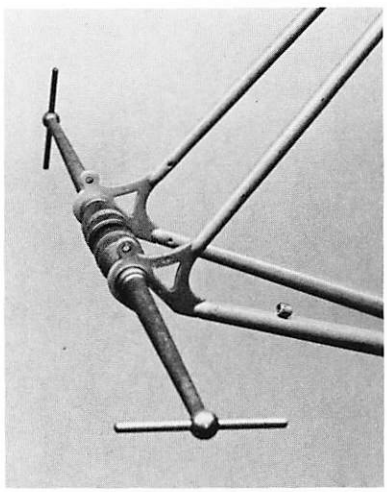


Figure 1. Fork end alignment gauges installed

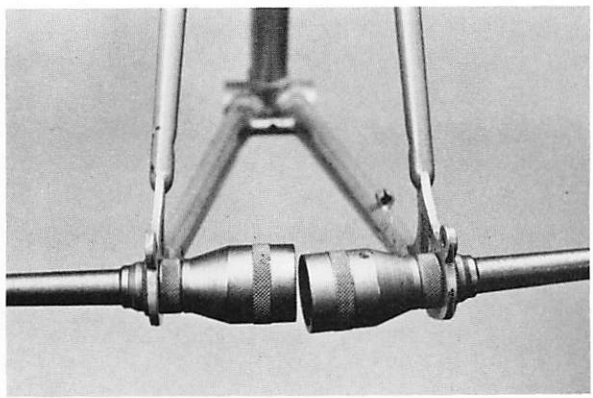


Figure 2. Fork ends out of alignment

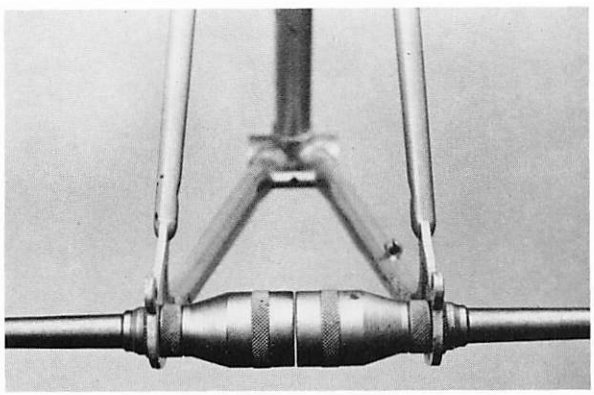


Figure 3. Fork ends aligned

BEARING MOUNTINGS (cont.)

Head Tube

The head set bearing cups seat in the ends of the head tube. The inside of the tube must be accurately reamed for a press fit and the ends of the tube must be milled parallel to align the cups. Bicycle Research Products, Campagnolo, VAR, and Zeus make tools which will do both of these operations; some head tools also serve as a press to install the cups. As shown in Figure 4, the head tool has a T-shaped handle, a flat milling cutter and a reamer mounted on a threaded rod. The rod is inserted in the head tube and a centering cone, a spring, and a star nut are installed at the other end of the tube. The nut should be tightened to compress the spring about half way. Flood the work area with cutting oil and rotate the tool clockwise, looking down on the handle. *Do not reverse direction* as this may cause the tool steel cutting edges to chip. As the tool turns, the reamer will go into the tube until the milling cutter contacts the tube face (Figure 5). More spring tension may be needed at this point. Further rotation will cut the face of the tube at precisely 90° to its axis. Continue cutting until there is bright metal all the way around the tube. (It may be necessary to remove the tool to check this.) After one end of the tube is finished, repeat the procedure for the other end. After both ends are done, clean the metal chips and cutting oil from the tube. The tool may be used to press the cups into the head tube. A centering thrust washer is installed between the reamer and the bearing cup, as shown in Figure 6. The centering cone and spring are not used in this operation. Make sure the cups start straight, then turn the handle until they are pressed tight against the tube ends (Figure 7).

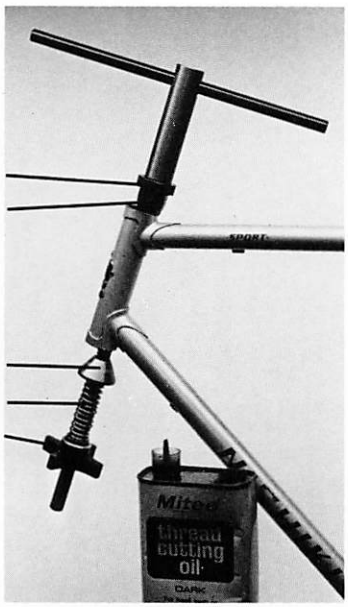


Figure 4. Assembly for milling and reaming head tube

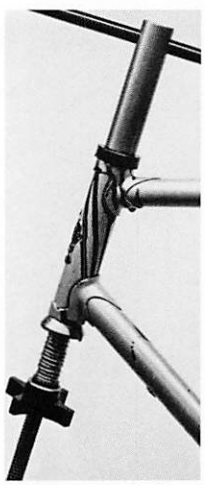


Figure 5. Milling and reaming head tube

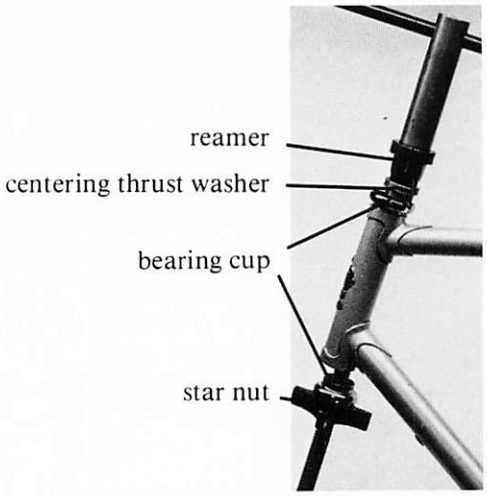


Figure 6. Head cup press assembly

Figure 7. Installing head cups with press

BEARING MOUNTINGS (cont.)

Steer Tube

To assure that the threads on top of the steer tube are aligned with the tube axis, the die cutting them must be held in a die stock provided with a suitable guide, (Figure 8). The top cone of the head set bearing depends on these threads for its alignment. Campagnolo, VAR, Zeus make the proper tools for this job.

Fork Crown

Where the steer tube enters the fork crown the diameter of the tube and the top of the crown must be machined to accept the headset bottom cone. This job is best done on a lathe, but an acceptable job may be done with a *crown race cutter* as made by Campagnolo, VAR or Zeus (Figure 9). The tool is slipped over the steer tube and the spring compressed to apply downward pressure to the hollow cutter. Using cutting oil rotate cutter clockwise until it leaves a complete circle of bright metal on the fork crown. Clean the fork and drive the bearing cone in place with a hollow slide hammer or a piece of 1'' water pipe.

Figure 8. Steer tube thread cutting

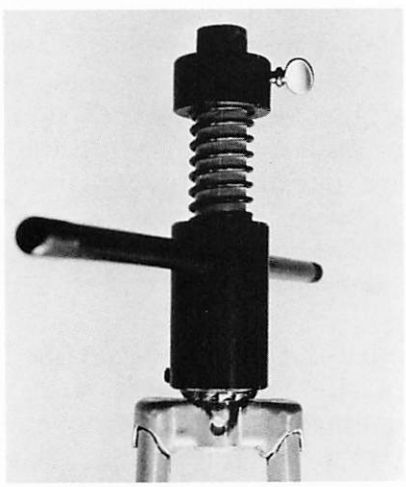


Figure 9. Fork crown race cutting

BEARING MOUNTINGS (cont.)

Bottom Bracket

The threads and the faces of the bottom bracket shell are the mount for the crank bearing cups. Even if these are accurately machined, they will probably be distorted during the brazing of the frame. Bicycle Research Products, Campagnolo, VAR and Zeus all make a double tap with an aligning pilot shaft that may be used to correct or cut these threads. Select the proper taps for the bottom bracket to be cut. (English and Swiss standards require left-hand threaded tap on chainwheel side, right-hand threaded tap on other side. French and Italian standards use right-hand threaded taps on both sides.)

Inspect the inside of the bottom bracket shell to make certain that none of the frame tubes extend into the path of the cutters. If they are in the way, they may damage the taps. Use a file for the slow and tedious job of removing the unwanted tube ends. Install the taps on the handles and insert the pilot shaft through the bottom bracket shell and into the hollow handle (Figure 10). Flood with cutting oil and start both taps into the shell at the same time (Figure 11). Run the taps in until there are enough threads to accept the bearing cups. Remove one tap and replace it with the flat facing mill and aluminum pilot (Figure 12). Insert the handle onto the protruding pilot shaft until the cutter is against the shell. Using cutting oil, press in and turn clock-wise *(do not reverse)* until the bright metal shows all the way around the end of the shell (Figure 13). Repeat on the other end of the shell, changing taps if required. Clean up chips and oil, including the chips hiding in the chain stays, and install the bottom bracket.

A bottom bracket shell that has stripped or badly damaged threads may be made as good as new by converting to Italian standard threading, unless it was already Italian thread. Remove the old threads using a Bicycle Research Product Bottom Bracket reamer on one side of the double tap handle, with a tap matching the threading in the shell threaded into the other side (Figure 14). Using cutting oil, push the reamer into the shell while turning it clockwise until the old threads are removed. Continue turning *clockwise* while pulling the reamer out of the shell. Without removing the tap, replace the reamer with an Italian tap and cut new threads.

Leave the Italian tap in the shell and remove the other tap. Replace this tap with the reamer and repeat the reaming and threading operations. This fast easy repair saves a ruined frame for the cost of the bearing cups and twenty minutes work. The old spindle may be used if serviceable.

BEARING MOUNTINGS (cont.)

In Conclusion

Always keep in mind that a bearing may only function if it is rigidly and accurately mounted. The more precise the bearing, the more vulnerable it is to misalignment.

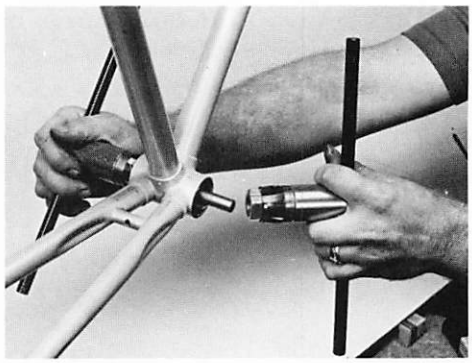


Figure 10. Installing double-sided tap with aligning shaft

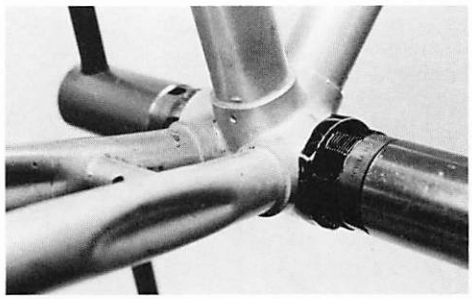


Figure 11. Starting taps

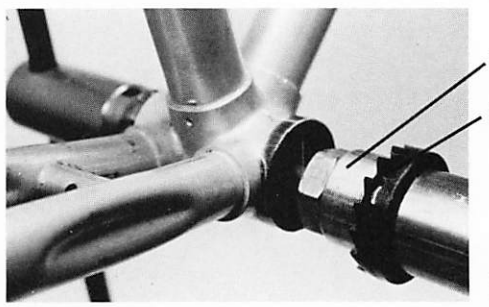


Figure 12. Milling assembly

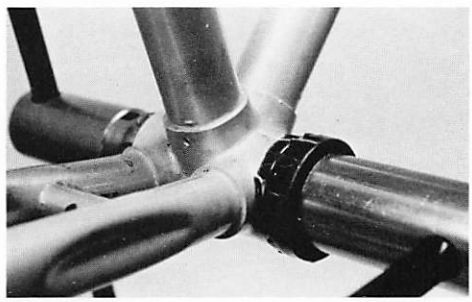


Figure 13. Milling bottom bracket face

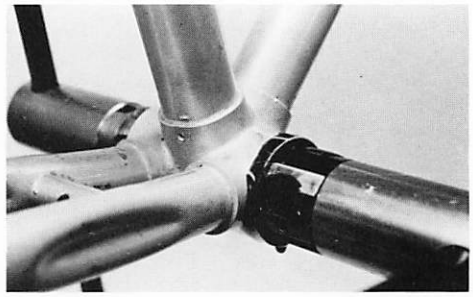


Figure 14. Reaming bottom bracket shell to remove stripped threads

HOW TO USE THIS BOOK

HAND TOOLS

Screwdrivers, pliers, wrenches, hammers, and various special tools are used in bicycle repair and assembly. The *quantity, quality* and *profitability* of work done in a shop generally matches what is found on the work bench. A good tool is a long term investment, but a poor or missing tool continues to run up expensive labor costs. Screw heads marred by a dull screwdriver or nuts rounded by an adjustable wrench tell a customer where not to take his bike next time.

For a shop doing repair work on all makes of bicycles many tools are needed. Consider the tools in the following list as a basic minimum for a profitable shop.

Wrenches

6mm through 17mm combination	1 each
6mm through 17mm box end	1 each
1/4" through 5/8 combination	1 each
1/4 through 7/16" British Standard Whitworth combination	1 each
13mm through 17mm cone wrenches	2 each
Pedal Wrench	1
6", 8", 12" and 16" adjustable wrenches	1 each
8mm through 15mm socket wrenches	1 each
Metric Allen Set	1 each
Inch Size Allen Set	1 each

Screwdrivers

1/8" or 3/16" wide blade type	1
1/4" or 5/16" wide blade type	1
Various sizes Phillips-type	3

Pliers

8" Slip Joint	1
7" Diagonal Cutter	1
6" Long Nose	1
12" Channel Lock	1
Cable Cutter	1

Hammers

1/2 lb Ball-peen	1
1 lb Rubber mallet	1

HOW TO USE THIS BOOK

Miscellaneous

Center Punch	1
Set Pin Punches	1
5" Bench Vise, 50 lbs or more in weight	1
6" (15 cm) Calipers	1
6" (15 cm) Machinist Scale	1
6' (2-Meter) Tape	1
2.5 m Flat Metric Tape	1
Hack saw	1
Files	1 each
Thread Pitch Gauge, Metric and English	1
6" Bench Grinder	1
Grinding Wheel Dresser	1
Wire Wheel	1
1/4" Drill and Bits	1

Special Bicycle Tools

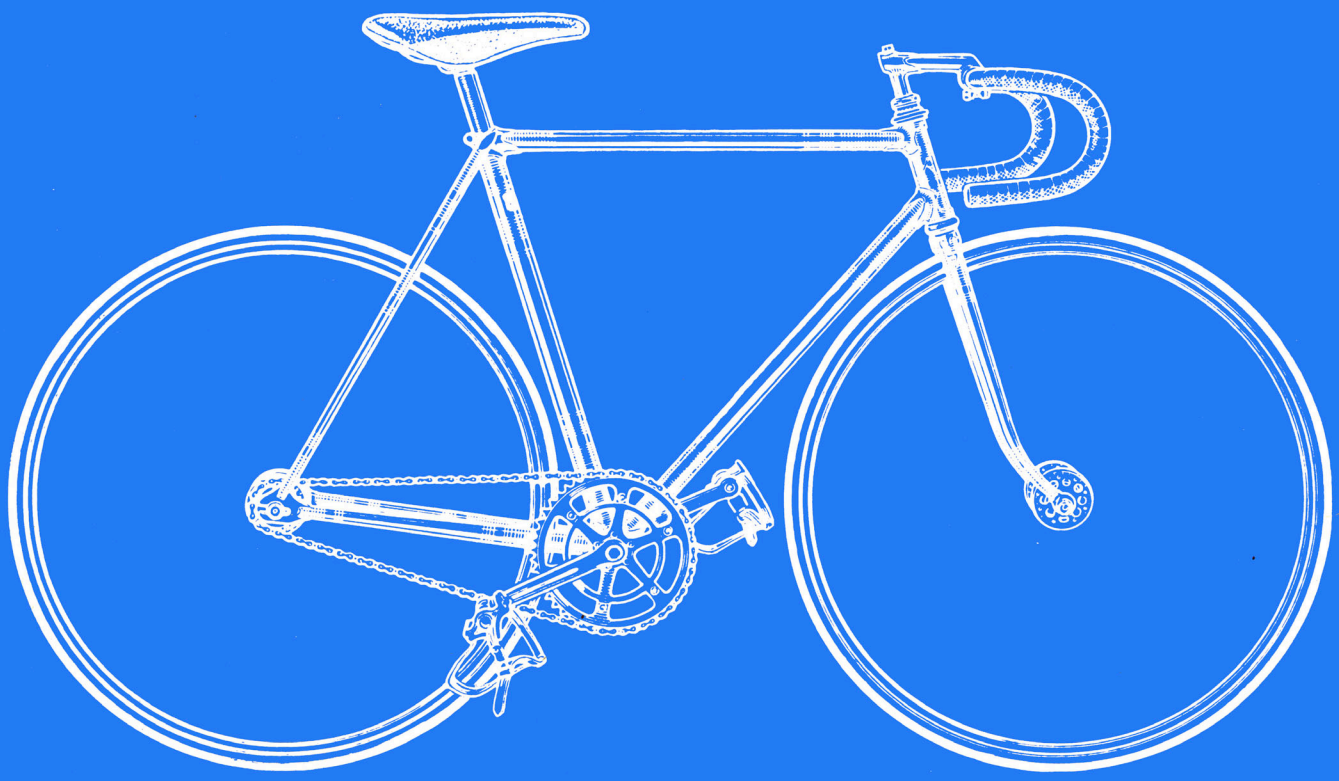
Every type Cluster Tool you can find	1 each
Every type Crank Extractor you can find	1 each
Shimano Ball Cup Tool	1
Spoke wrenches	1 each
1/2" and 9/16" left and right pedal taps	1 each
Bottom Bracket Fixed Cup Remover	1
Bottom Bracket Lock Ring Tool	1
Bottom Bracket Peg Spanner	1
Cotter Pin Press	1
Cup Press	1
Third Hand Brake Tool	1
Fourth Hand Brake Tool	1
Chain Wheel Tool	1
Axle Thread Chasers	1 set
Various special Shimano tools	1 each
Chain Rivot Extractor	1
Wheel Dishing Tool	1
Repair Stand	1
Truing Stand	1
Sutherland's Handbook	1

ONE LAST WORD ABOUT TOOLS:

Cheap tools are an extravagance no bicycle shop can afford.

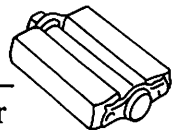
— NOTES —

Cranks
Chain
Chainwheels



PEDALS

PEDAL-CRANK



BALL SIZES: Most pedals use 10 to 12-5/32" balls per bearing. Exception: Campagnolo Super Record uses 16-1/8" balls.

THREAD SIZES

English	9/16"x20 TPI	Right and left handed thread
French*	14mmx1.25mm	Right and left handed thread
Italian	9/16"x20 TPI	Right and left handed thread
U.S.A.	1/2"x20 TPI	Right and left handed thread

Italian threads are slightly different than English and are a tighter fit in English threaded cranks.

*Peugeots and some other French bicycles have recently started using English 9/16x20 TPI for the U.S. market.

French Cranks can be easily tapped to 9/16 x 20.
When retapping pedal threads start from the back of the crank arm.

ID MARKINGS ON WRENCH FLATS

Campagnolo and others

English, Italian	9/16x20
French	14x1.25

Zeus

English, Italian	BSC
French	no mark

ID MARKINGS ON CRANK ARMS

European

English, Italian	9/16x20
French	14x1.25

Japanese

English	no mark
French	M14

ID PEDAL CODES FOR RIGHT AND LEFT HANDED THREADS

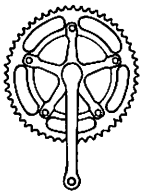
	Right	left
English	R	L
French	D	G
Italian	D	S
Spanish	D	I

TOE CLIP BOLT—PEDAL

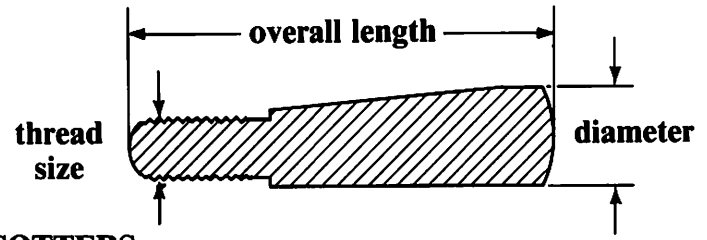
The following use 5mmx0.8mm threads:

Pedals	Toe Clips
Campagnolo	Christophe
Lyotard	KKT
Olympic	Milremo
Pro Ace	Verme
Zeus	

and most others with threaded holes



CRANKS, CHAINWHEELS AND CHAIN



CRANK COTTERS

National Tendencies and others	Diameter	Overall length without nut	Thread size	Flat
English	9.5 (3/8")	43	6.7mm x 26 TPI	moderate
French	9.0	40, 43	7.0mm x 1mm	moderate
German	9.5, Common 9.0	43 43	7.0mm x 1mm 1/4" x 26 TPI	moderate
Italian	9.0, Common 8.5	43 41.5	7.0mm x 26 TPI 7.0mm x 26 TPI	short steep cut
Japanese	9.5	41.3*	6mm x 1.0mm Japan Standard 1/4" x 26mm also common	
Peugeot old style	9.0	37.5	6mm x 1mm	entire length of body cut
new style	9.0	42	7mm x 1mm	moderate
Steyr	9.5	45	1/4" x 26 TPI	entire length of body cut
Thompson (adult) (child)	9.5 8.0	42.5 43	1/4" x 26 TPI 1/4" x 26 TPI	moderate cut moderate cut
Windsor	8.5	41.5	1/4" x 26 TPI	short steep cut

*S.R. alloy cottered cranks use extra long cotters.

➔ 8.5mm and 9.0mm holes in cranks may be drilled out to accept 9.5mm cotters. Use a 3/8" drill.

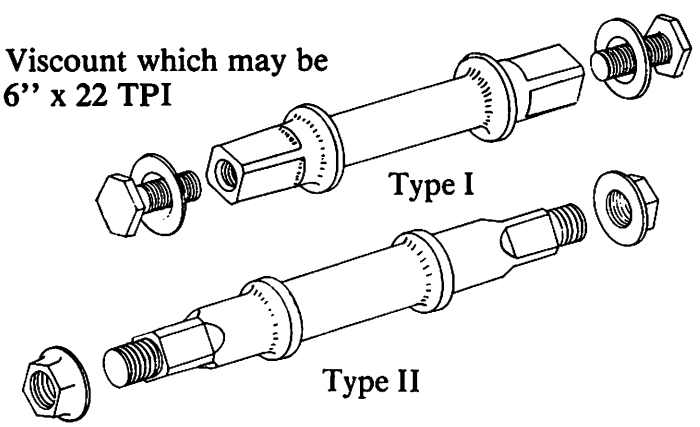
COTTERLESS CRANK AXLES

CRANK BOLTS AND NUTS

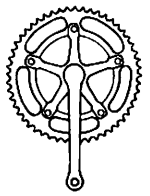
THREAD SIZES

Type I 8mm x 1.0mm, except Viscount which may be 5/16" x 26 TPI or 5/16" x 22 TPI

Type II 10mm x 1.25mm



CRANKS, CHAINWHEELS, CHAIN



COTTERLESS CRANK EXTRACTORS

All extractors we measured except Lambert* have the same pitch—1 thread per millimeter. The thread diameter of all the extractors listed as common are very close to the same. Variations do occur in manufacturing. Even tools made by the same company are different from batch to batch. Keep several tools around. If the tool goes in too tightly or too loosely, try another to match the thread more closely.

➡ The Park tool will fit Standard, Type II, and TA. Don't use the Park tool on Stronglight cranks.

Type II extractors have standard threads but must be used for pulling cranks from Type II axles.

	Type Axle**	Crank Bolt Head Size	Extractor
Campagnolo	I	15mm	Standard
Nervar	I	14mm	Standard
Shimano Dura Ace	I	14mm	Standard
SR (Sakae Ringyo)			
Royal	I	14mm	Standard
Custom	II	14mm	Type II
Apex	II	14mm	Type II
Silver	II	14mm	Type II
Sugino			
Mighty	I	15mm	Standard
Maxy	II	14mm	Type II
Stronglight	I	16mm***	Stronglight, Var 22
TA	I	15mm	TA, Var 408
Tagaki			
Tourney	II	14mm	Type II
CL (no mark on arm)	II	14mm	Type II
Viscount	I	15mm	Standard
Zeus	I	16mm****	Standard

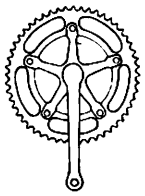
*Early Lambert extractor holes were threaded 7/8 x 24 TPI.

**See page 2-0 for drawings of axle types

***Use thin wall socket with outside diameter no larger than 22mm

****Use Zeus tool or a very thin wall socket with outside diameter no larger than 20.8mm. If you ever get it out, you can use a 15mm bolt instead.

➡ To remove frozen crank dust caps drill two small holes in them and use a pin tool to remove them.



CRANKS, CHAINWHEELS AND CHAIN

INSTALLING COTTERLESS CRANKS

Adjust the chainline by selecting the appropriate parts—usually the correct length axle (see Bottom Bracket Axles page 3-8). The cranks mount in one position. Do not overtighten or leave loose to adjust the position.

Adjust the bottom bracket bearings with the cranks off. Install the right crank. Check bearing adjustment by putting side force on the end of the crank. Readjust until no play is felt. Install left arm.

The axle end and the hole in the crank must be clean and dry. Do not use oil, grease, or an anti-sieze compound. The tapered square system depends on the crank coming up firmly on the axle. Any lubrication will cause the arm to go on too far in tightening or to float on the axle. Either way the arm will be ruined. Grease or anti-sieze compound may be used on the threads of the crank bolt.

Tighten the crank bolt firmly: 18-20 foot pounds (215-240 inch pounds). Hold a heavy block of wood against the opposite end of the axle (or against the opposite crank). Rap the crank you're tightening sharply with a mallet (fiber, wood or plastic). Then re-torque the bolt. This insures that the crank seats properly on the axle.

FIT BETWEEN CRANK ARMS AND AXLES

There is some variation in angle between the different crank makers as well as between various axles by the same maker.

Alloy cranks for Type I axles use an axle with a tapered end of about 2° from the center line.

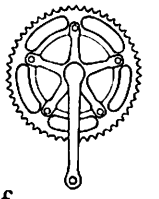
Generally, forged aluminum cranks for Type II axles use 2°; cast aluminum cranks for Type II axles use 3°.

The alloy crank arm is soft and will conform to the shape of the axle. To prevent wear of the crank hole, you should not make the crank conform to differing axle configurations. Whenever possible, avoid switching back and forth between two makes of axles.

➔ When using the interchangeability charts, tighten the crank on the axle to check the fit before installing it on the bike.

Be sure the crank does not come up against the end of the taper. This happens first near corners of holes. If crank bottoms out, the square holes do not grip well, and will come loose or possibly crack. (See drawing A)

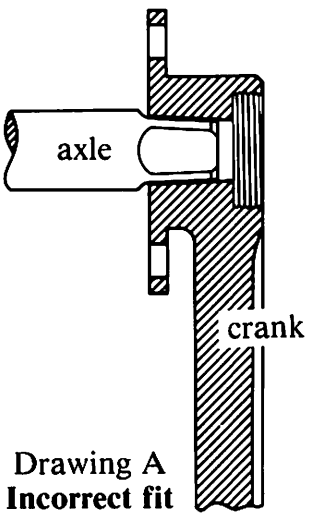
CRANKS, CHAINWHEELS AND CHAIN



FIT BETWEEN CRANK ARMS AND AXLES (cont.)

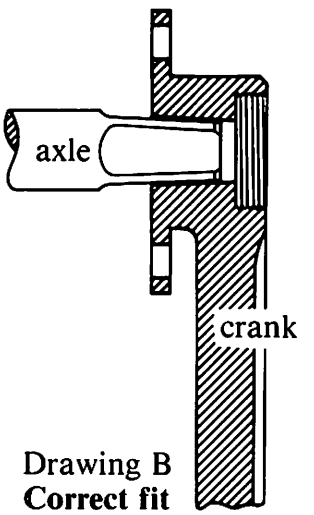
After tightening, remove bolt to check that the end of the axle is not coming through. If the axle end is flush or near flush with the face of the crank bolt washer it sits against (see drawing C), the crank itself may not be tight enough or will loosen when ridden. Attempting to tighten the crank bolt further with this condition present will shear off the bolt, since it would be tightening against the axle end itself.

Sometimes you can use a washer between arm and normal washer. File the hole in an unhardened washer so the axle end corners can pass through it.



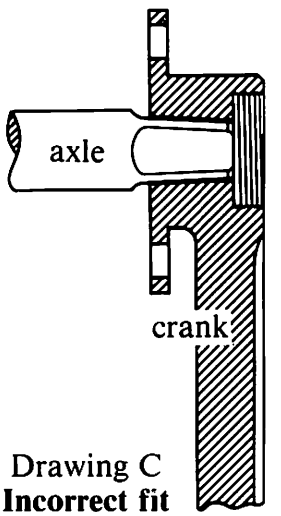
Drawing A
Incorrect fit

Crank close to "bottoming" on end of taper flats.



Drawing B
Correct fit

Axle end is not flush with bottom of crank extractor hole and crank arm does not "bottom" on end of taper flats.



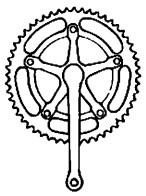
Drawing C
Incorrect fit

Axle end flush, or close to flush, with bottom of extractor hole.

MISCELLANEOUS ITEMS

If you are using light alloy crank bolts, do not use them to install the cranks. Use normal steel bolts to tighten and re-tighten the arms. Then remove the steel bolts and install the alloy bolts. Tighten them finger-tight, then just enough more to tension them.

Always replace the dustcaps. They prevent damage to the threads. Damaged threads may make it difficult or impossible to install an extractor. A small amount of grease on dust cap threads will prevent corrosion.



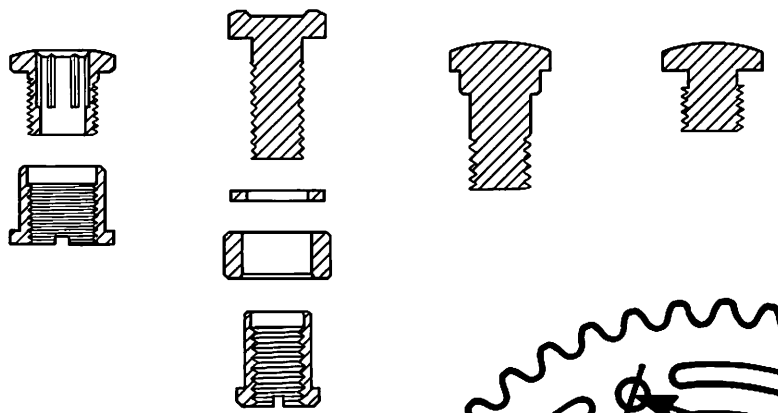
CRANKS, CHAINWHEELS AND CHAIN

CHAINWHEEL BOLTS

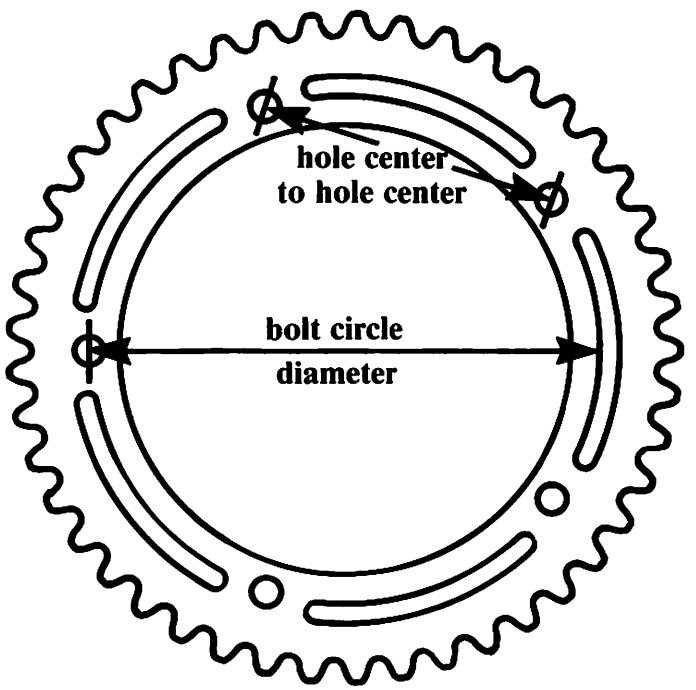
Bolt head sizes vary more than the thread sizes. Hex headed bolts should be tightened and loosened with a socket or box end wrench that has a face that has been ground flat.

	thread	hole in arm, chainwheel or spacer	
Type A	8x.75	10	use 5mm allen key, slotted nut
Type B	6x1	8	use slotted nut
Type C	7x1	threaded 7x1 or 7mm un-threaded	collar diameter 8.9mm
Type D	7x1	7x1 threaded	
Type E	5x.80 or 5x.75	7 or 8	uses slotted nut or 4mm allen key

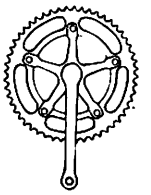
Type A Type B and E Type C Type D



CHAINWHEEL DIMENSIONS



CRANKS, CHAINWHEELS AND CHAIN



CHAINWHEEL INTERCHANGEABILITY

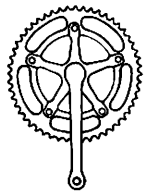
3 ARM CHAINWHEELS

Chainwheels listed together are interchangeable

Bolt circle diameters	Hole center to hole center	Make	Model	Bolt type	Hole size	Min. No. teeth
85	73.5	Sakae (SR)	Custom 3	A	10	28
88.9 (3½")	77	Nicklin Cross Williams	N34 N34 C34			
95	82.3	Shimano	600,310	A	10	30
106	92	Dague Mundo Sakae (SR) Sugino Takagi (3 arrows)	Caloi Apex w/ 8mm holes Maxy, others Tourney American Flyer and others	B	8	34*
106	92	Sakae (SR)	Apex w/ 10mm holes	A	10	34
112	97	Takagi (3 arrows)	1 piece crank	D	8	
116	101	Campagnolo Cinelli Duprat Durax Gnutti Haubtmann Magistroni Nervar Simplex Solida Stronglight TA, TA Adapter Ring Zeus and others	Sport Professional	CorD	9	36**

*Chainrings come in steel and aluminum; there are different spacers for each. Generally 5mm spacers for steel and 3.5mm for aluminum.

**Often attaches to spigots (raised bumps) on crank arms. This bolt circle is often used with a larger (157mm) bolt circle. Sometimes a piece of metal that looks like this joins the two circles. Nervar, Haubtmann, Solida, Zeus, and most others are 78.5mm between hole centers. Some Italian chainwheels with this large bolt circle use unevenly spaced holes. Pairs of holes were spaced 63.4mm apart on ones we measured.



CRANKS, CHAINWHEELS, CHAIN

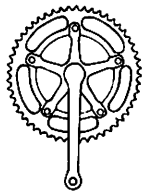
CHAINWHEEL INTERCHANGEABILITY (cont.)

5 ARM CHAINWHEELS

Chainwheels listed together are interchangeable.

Bolt circle diameter	Hole center to hole center	Make	Model	Bolt type	Hole size	Min. teeth
74	43.4	Avocet Ofmega	Touring 2000	Special	10	24
86	50.5	Stronglight Sakae (SR)	99, 49 Tri inner Apex and others	A	10	28
95	55.8	Takagi (3 arrows)	Tourney Touring	A	10	30
95	55.8	Takagi (3 arrows)	Tourney Standard Touring	B	8	30
100	58.8	Campagnolo Merz	Triple Adapter	Special A	10 10	36 31
102	60.0	Avocet Ofmega	Touring 2000	Special	10	32
110	64.7	Sugino Shimano	Maxy, BMX, others 600 EX MD	A	10	34
112	65.8	Takagi (3 arrows)	For 1 piece cranks	D	6	34
114	67.0	Schwinn Approved Takagi (3 arrows)	For 1 piece cranks	D	6	39
116	68.2	Campagnolo	Grand Sport	A	10	36
118	69.4	Sakae (SR)	Apex and others	A	10	36
120	70.5	Zeus		A	10	36
120	70.5	Takagi (3 arrows)	For MX 1/8" chain	B	8	36
122	71.7	Stronglight Stronglight Stronglight	93 49 inner only 104, 105	A	10	38
128	75.2	Nervar Nervar	Star Sport	A	10	38
130	76.4	Sakae (SR) Shimano Shimano Schwinn Approved Takagi (3 arrows)	Apex, and others Dura Ace Road Dura Ace Track (old style) 600 EX LD Le Tour Deluxe Tourney Racing SP	A	10	39

CRANKS, CHAINWHEELS AND CHAIN

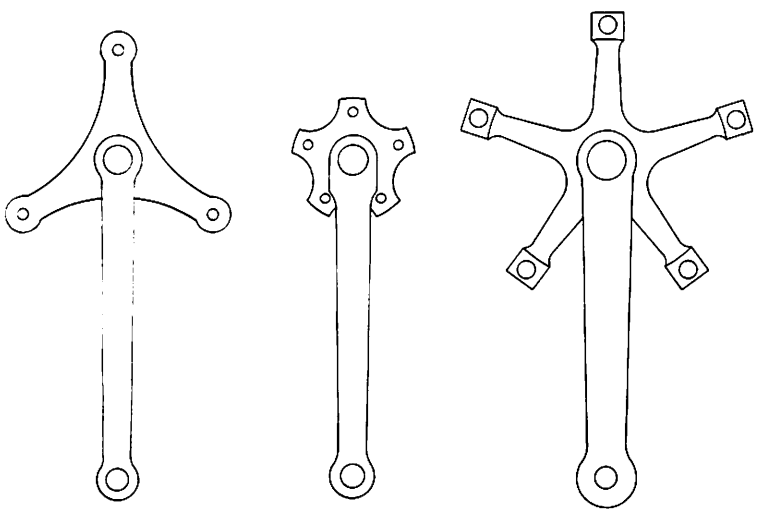


CHAINWHEEL INTERCHANGEABILITY (cont.)

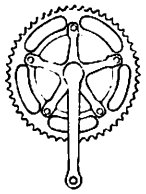
5 ARM CHAINWHEELS

Chainwheels listed together are interchangeable.

Bolt circle diameter	Hole center to hole center	Make	Model	Bolt type	Hole size	Min. teeth
130	76.4	Schwinn Approved	Le Tour	B	8	39
		Takagi (3 arrows)	Tourney Racing Standard			
144	84.6	Campagnolo	Road	A	10	42
		Avocet				
		Nervar	2000			
		Ofmega				
		Omas	Royal, others			
		Sakae (SR)				
		Stronglight	106			
		Sugino	Mighty, others			
		Tevano				
151	89.0	Campagnolo	Track	A	10	44
		Campagnolo	Road (pre '67 old style)			
		Sugino	Mighty Track			
		Zeus	Competicion inner			
		Williams				
		Shimano	Dura Ace Track (current)			



3 arm 5 pin 5 arm



CRANKS, CHAINWHEELS, CHAIN

CHAINWHEEL INTERCHANGEABILITY (cont.)

5 PIN CHAINWHEELS

Chainwheels listed together are interchangeable

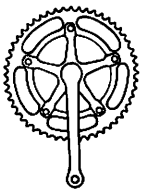
Bolt circle diameter	Bolt hole center to bolt hole center	Make	Model	Bolt type	Hole size	Min. teeth
50.4 *	29.6	Many, including: Cinelli Duprat Durax Gnutti Huret Nervar Simplex Stronglight Sugino TA Williams Zeus	 1004,1006 Pro Dynamic			
6 BOLT CHAINWHEELS						
80	40	TA Lambert	Cycle Tourist middle bolt circle	E	7.2	26
116	58	TA	Randonneur	E	7.2	36
143	71.5	Lambert	outer bolt circle	E	7.2**	
152	76	TA	Criterium	E	7.2	43
157	78.5	Nervar Haubtmann RFG Solida Simplex Zeus and others				

Notes

* This is a common bolt circle used with a 40mm hole in the chainwheel. Bolt sizes are frequently 5x.75 or 5x.80. Hole sizes in aluminum chainwheel are frequently 7 or 8mm or are threaded for 5mm bolt in steel chainwheels.

** Hole threaded on inner ring.

CRANKS, CHAINWHEELS, CHAIN



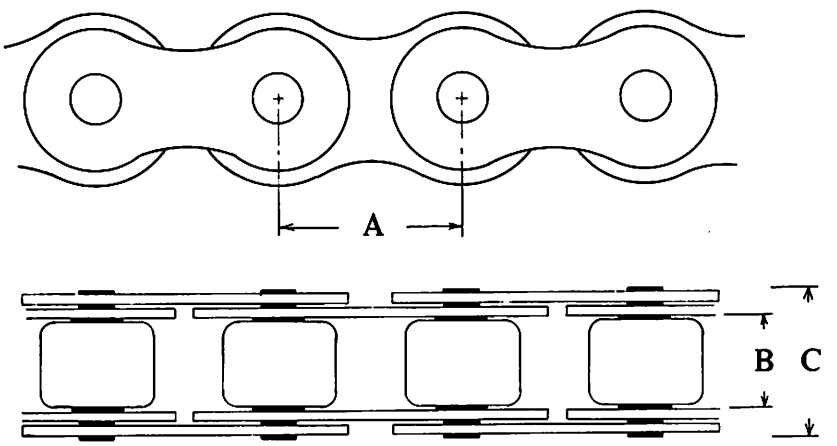
CHAIN

	nominal size in inches	nominal size in millimeters
Hub Gears and Coaster Brakes	1/2" x 1/8"	12.7 x3.17 or 12.7 x 3.3
Derailleurs	1/2" x 3/32" 1/2" x 1/8"*	12.7 x 2.38 12.7 x 3.17 or 12.7 x 3.3
Block Chain (now obsolete)	1" x 3/16"	25.4 x 4.76

*Used for 2,3 and sometimes 4 and 5 speed freewheels

CHAIN MEASURING

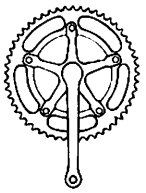
The first number refers to the pitch or the distance between the center of one roller and the center of the next roller bearing the same load (dimension A). The second number refers to the distance between the inside plates or the smallest space for the tooth of the sprocket (dimension B). Nominal and actual sizes are not exactly the same.



Narrow Derailleur Chain

Narrow chain such as Sun Tour Ultra 6 and Sedisport has the same internal dimension (B) as ordinary 1/2" x 3/32" chain.The outside dimension (C) is smaller. Ordinary chain is approximately 8.0mm wide while narrow chain is 7.2 to 7.4mm wide. This difference allows a 6 speed freewheel to be used in the space of an ordinary 5 speed freewheel.

Ordinary width chain cannot be used on narrow 6 and 7 speed freewheels.



CRANKS, CHAINWHEELS AND CHAIN

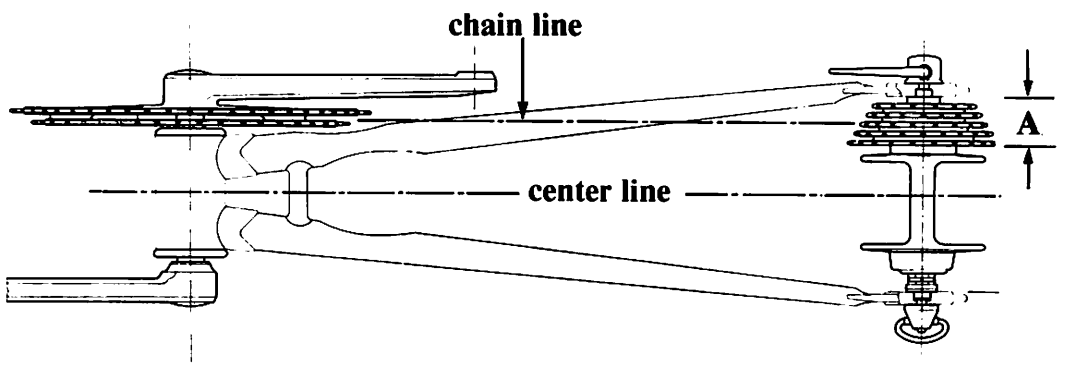
CHAINLINES

Front chainline refers to the distance from the bicycle centerline to chainwheel midpoint. Rear chainline is the bicycle centerline to sprocket midpoint. Front and rear chainlines rarely match in practice. Chainwheels are frequently moved out to avoid having the chain rub on the outside chainwheel when the gears are in a small chainwheel and small sprocket combination. Also, sometimes the frame will be built with the right fork end out further than the left.

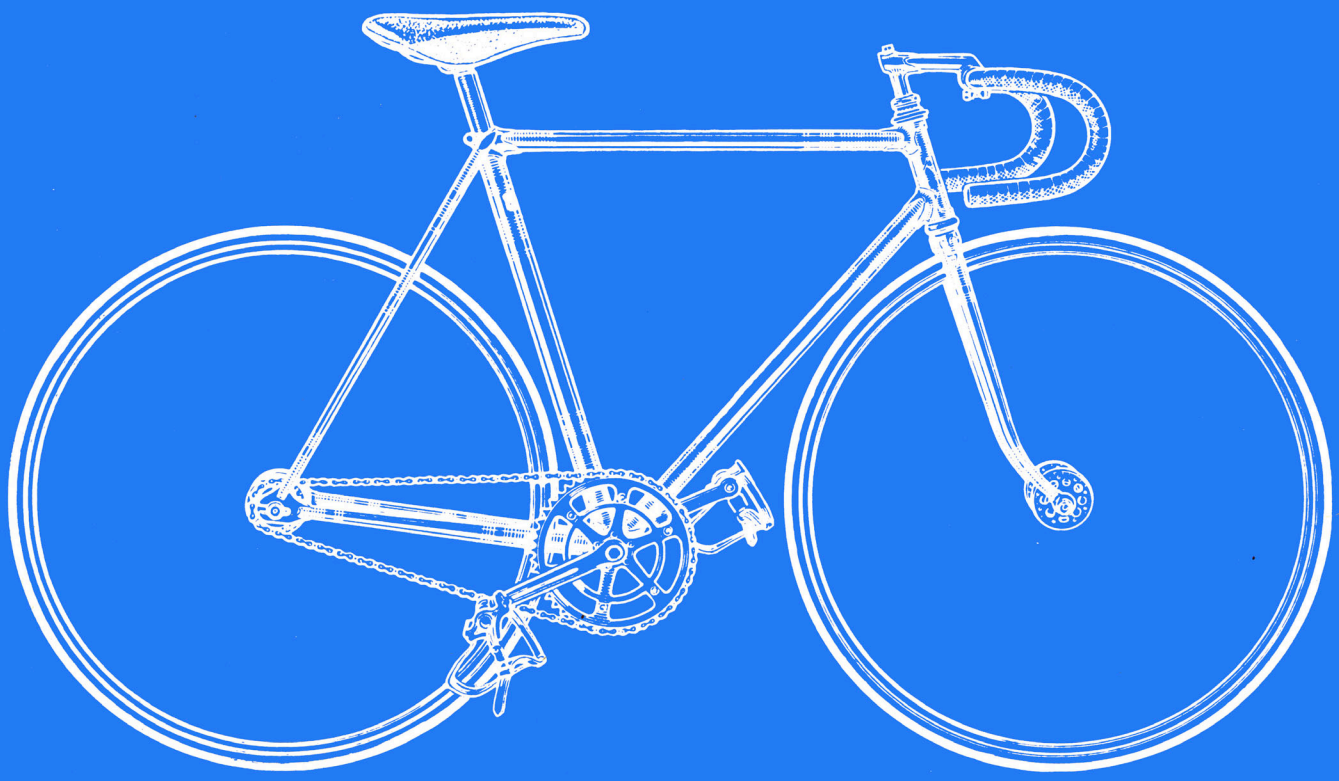
REAR CHAINLINE

	Hubwidth mm	A mm	Freewheel Thickness mm	Chainline mm
Track	110	21.5		40
	120	24		42.5
Campagnolo type				
with regular spaced 5 speed freewheel or narrow spaced 6 speed freewheel.	120	29	25	43.5
with regular spaced 6 speed freewheel or narrow spaced 7 speed freewheel.	125	34	30	43.5
French				
with regular spaced 5 speed freewheel or narrow spaced 6 speed freewheel.	122	34	25	39.5
with regular spaced 6 speed freewheel or narrow spaced 7 speed freewheel.	124	36	30	40.0
Japanese				
with regular spaced 5 speed freewheel or narrow spaced 6 speed freewheel.	125	34	25	43.5

Also see page 11-2 and 11-3.



Bottom Brackets



BOTTOM BRACKETS

BOTTOM BRACKET CUPS—BOTTOM BRACKET SHELL

3-PIECE CRANKS

BALL SIZES: 11 - 1/4" balls per side. Exceptions: Campagnolo used 3/16" balls one year in the mid-1960's, Campagnolo Super Record uses 14-3/16" balls per side.

THREAD SIZES:

		Adjustable Cup	Fixed Cup
English	1.370"x24 TPI*	right handed thread	left handed thread
French**	35mmx1.0mm	right handed thread	right handed thread
Italian	36mmx24 TPI	right handed thread	right handed thread
Raleigh***	1 3/8"x26 TPI	right handed thread	left handed thread
Swiss	35mmx1.0mm	right handed thread	right or left handed thread.****
Chater Lea*****	1.450"x26 TPI	right handed thread	left handed thread

* Phillips bottom bracket cups are described by Raleigh as being 1 3/8" x 24 TPI Whitworth. This is different from the British Standard Cycle. See Thread Measuring page 0-3 for a description of thread differences.

** Motobecane uses left threaded (Swiss style) fixed cup on most bikes. For cottered cranks, if fixed cup has 8 flats it is left threaded; if it has 2 flats it is right threaded. For cotterless cranks see page 3-2 for markings on left threaded cups.

*** Raleigh, Rudge, Humber and brands made by Raleigh after 1963 except bikes made by Carlton which uses 1 x 24 TPI. A Raleigh with 71 or 76mm bottom bracket shell generally uses 26 TPI. 67 or 68mm shells use 24 TPI.

**** See page 3-2 for markings on left threaded bottom bracket cups.

***** Obsolete British size sometimes found on tandems and others.

Phil Wood & Co. makes mounting rings for their sealed crankbearings to fit all the bottom bracket threads listed above including Chater Lea.

When chasing right hand threaded bottom bracket threads with a pilotless tap, use a lockring threaded onto the tool to judge straightness.

➡ All stripped bottom bracket threads except Italian can be reamed out and rethreaded to Italian. Use a size K expansion reamer or a Bicycle Research bottom bracket reamer.

Viscount bottom brackets can be reamed and tapped to Italian. Be sure to replace the aluminum forks. They break without warning.

BOTTOM BRACKETS

BOTTOM BRACKET CUP MARKINGS

	FIXED CUP	ADJUSTABLE CUP
CAMPAGNOLO		
English	1.370" x 24 TPI	1.370" x 24 TPI
French	35 x 1	35 x 1
Italian	36 x 24F	36 x 24F
Swiss (left thread)	35 x 1G	
JAPANESE		
English	1.37" x 24T	1.37" x 24T
French	35 x P1	35 x P1
Italian	36 x 24T	36 x 24 T
Swiss (left thread)	35 x P1 S1	
NERVAR		
English	1 ring 2 flats	1 ring 6 sides
French	no ring	no ring 6 sides
Italian	2 rings 2 flats	2 rings 6 sides
RFG		
English	CL	4CR
French	C	C
German	GL	DR
Italian	2 Flats	4 Pin Holes
Raleigh	No Flange	—
STRONGLIGHT*		
English	2 rings 8 sides	6 sides no rings
French	1 ring 8 sides	6 sides no rings
Italian	1 ring 8 sides or 1 ring 2 flats	4 pin tool holes no rings
Swiss (left thread)	no rings 8 sides	
TA		
English	2 rings	2 rings
French	1 ring	1 ring
Italian	no rings	no rings

*Stronglight competition all sizes have 2 flats, no rings.

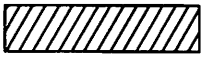
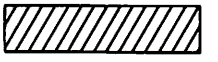
— NOTES —

BOTTOM BRACKETS

BOTTOM BRACKET CUP LOCK RINGS

ID

MARKINGS ON LOCK RING EDGES

	NERVAR	TA
English		
French		
Italian		

STRONGLIGHT

English 4 or 8 notch*
French 6 notch
Italian 4 or 8 notch*

*Italian lockrings slip over English Bottom Bracket Cups and English lockrings can't fit over Italian Bottom Bracket Cups

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Thompson (Thun) Bottom Brackets Sets

For Bottom Bracket Shells (inside diameter by width)	40 x 65, 40 x 70	45 x 65, 45 x 70	30 x 65, 30 x 70
axle diameter	5/8" (15.8mm)	5/8" (15.8mm)	13mm (.511")
length	5 1/2" (140mm)	5 1/2" (140mm)	137mm (5 1/4")
ball size	1/4"	5/16"	3/16"
cotter size	3/8" (9.5mm)	3/8" (9.5mm)	8mm
locknut size	26mm (1.02")	26mm (1.02")	—

Adjustable left side is left threaded. Be sure indentations in left dust cover line up with slot in cone. Tighten locknut by holding crank arm on other side. Leave cone on right side in place.

ONE PIECE (ASHTABULA) CRANKS

THREAD SIZES AND BALL RETAINERS

	right threaded right side (stationary cone)	left threaded left side (adjustable cone)	Retainer	Ball number and size
USA	15/16 x 24 TPI	7/8 x 24 TPI	66	10-5/16
Schwinn	15/16 x 28 TPI	7/8 x 28 TPI	64	9-5/16

SUTHERLAND'S HANDBOOK FOR BICYCLE MECHANICS

ENGLISH COTTERED AXLE INTERCHANGEABILITY

The following chart was compiled from five different sources. Numbers are rounded to the nearest 1/16" or .5mm. There may be minor discrepancies but none that should affect the interchangeability. Please write if you have any problems with this chart.

➡ Axles on the same line are interchangeable but may not have precisely the same dimensions.

Axles within each center size category are arranged in order of increasing right side. In cases where this right side is the same they are listed in order of increasing left side.

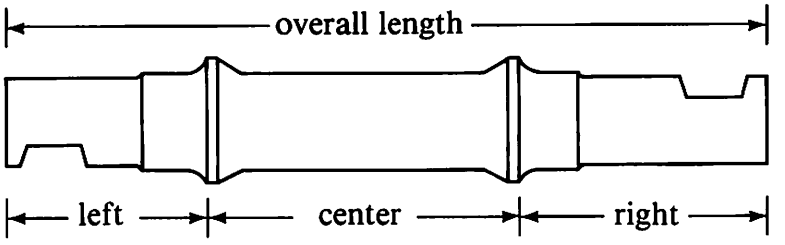
Many of the axles listed are no longer being made and are listed only so that replacements can easily be made. Hercules, Brampton, Bayliss Wiley and Phillips that have only the old stamping number are no longer manufactured. Phillips with 7 digit numbers listed, Raleigh, TDC, Japanese JBG and RFG axles are still available.

shading indicates most commonly used axles

Centers	left	center	right	total	Raleigh Sales no.	Raleigh Amer. Ref. no.	Raleigh no. on axle	Phillips sales no.	Phillips no. on axle (current)	Phillips no. on old axle	TDC sales no.	TDC no. on axle	RFG no. on axle	Bayliss Wiley no. on axle	Hurcules no. on axle	Brampton no. on axle	Japanese JBG no.	Notes
1 11/16" (43.0mm)	1 5/16 (34.0)	1 11/16" (43.0)	1 5/8" (41.5)	4 5/8" (117.5)				PBA 601		F103	C16/6	6		20				Miniature cycles
1 15/16" (49.0mm)	1 7/16" (36.5)	1 15/16" (49.0)	1 11/16" (43.0)	5 1/16" (129.0)							C16/7	7		1				
2 1/16" (52.5mm)	1 5/16 (33.5)	2 1/16 (52.5)	1 5/16 (33.5)	4 11/16 (119.0)				PBA604		F102				15				Single chainwheels
	1 5/16 (33.5)	2 1/16 (52.5)	1 3/8 (35.0)	4 3/4 (121.0)							C16/2 S19/2	2						
	1 5/16 (33.5)	2 1/16 (52.5)	1 7/16 (36.5)	4 13/16 (122.0)				PBA510		F122	C16/9 S19/9	9		23R				5 speeds
	1 5/16 (33.5)	2 1/16 (52.5)	1 5/8 (41.5)	5 (127.0)				PBA512	3900431	F101				14	MC34	BBA280	3758	
	1 5/8 (41.5)	2 1/16 (52.5)	1 5/8 (41.5)	5 1/4 (133.5)				PBA506		F139				8				
	1 5/16 (33.5)	2 1/16 (52.5)	1 11/16 (43.0)	5 1/16 (129.0)				PBA504		B113	C16/4 S19/4	4	4					10 speeds
	1 3/8 (35.0)	2 1/16 (52.5)	1 3/4 (49.5)	5 1/4 (133.5)				PBA513	3900437	R109	C16/5 S19/5	5		2C	MC3GC	BBA261	3759	
2 3/16" (55.0mm)	1 5/16 (33.5)	2 3/16 (55.0)	1 7/16 (36.0)	4 15/16 (126.0)	RBA104	A16	16				C16/10	10						
	1 5/16 (33.5)	2 3/16 (55.0)	1 9/16 (39.5)	5 (127.0)	RBA103	A23	23											
	1 11/32 (34.0)	2 3/16 (55.0)	1 13/16 (46.0)	5 11/32 (135.0)	RBA105	A16GC	16GC				C16/11	11					3760	Raleigh 1,3,5 most 10 speeds.
	1 5/8 (39.0)	2 3/16 (55.0)	1 7/8 (47.5)	5 11/16 (144)	RBA 102	22	22											Raleigh Tandem
2 7/16" (62.0mm)	1 7/32 (32.0)	2 7/16 (62.0)	1 3/4 (44.5)	5 7/16 (137.0)	RBA108	A8	08GC				R16/8	8	A8GR				3757	RSW 16, Tourist
	1 7/16 (36.0)	2 7/16 (62.0)	1 3/4 (44.5)	5 5/8 (148.0)	RBA101	A21	21GC	PBA508	3900709	F104				12				Chopper, Twenty
	1 11/16 (43.0)	2 7/16 (62.0)	1 11/16 (43.0)	5 1/2 (142.5)							R16/14	14		3				Delivery (Carrier)

Note: all 2 7/16" center axles listed have close to the same right side and vary mostly on the left. They can be interchanged given enough clearance on left.

BOTTOM BRACKETS



BOTTOM BRACKET SHELL AND COTTERED AXLE CENTER WIDTHS

This chart lists only tendencies. There are exceptions so measure to be sure. Axle centers listed are mostly for cottered axles. Bottom bracket axles are made to be used with a specific cup thickness. Different cup thicknesses may cause interchangeability problems.

	Shell width	Cottered Axle centers	Uses
English (for Raleigh, see below)	2 19/32" - 2 5/8" (66-67mm) often listed as 68mm	2 1/16" (52.5mm)	Road and track
French	68mm	54.5 - 56.5mm	Road and track
Italian	70mm 65, 68, 70mm	56.5 - 58mm varies	Road Track
Japanese	68mm 71mm	52 - 53mm 55mm	Varies
Exceptions:			
Cinelli (model SC for several years in the '60's)	74mm		
Raleigh	2 13/16" (71mm)	2 5/32" (55.0mm)	Most Raleighs except bikes with 24 TPI threads.
	3" (76mm)	2 7/16" (62.0mm)	Tourist, Chopper, Twenty, others
Thompson (Thun)	65mm, 70mm	see page 3-3	3 piece style cranks with press-in cups and threaded axles.

COTTERED BOTTOM BRACKET AXLES

AXLE END DIAMETER

	Nominal	Actual
English	5/8" (15.88mm)	15.75 - 15.80mm
French	16mm	15.9mm
Italian	16mm	15.9mm

French bottom bracket axles are catalogued by overall length

overall length	left	center	right	markings on axles	notes
Gitane—all black					
130	33	56	41	none	
134	35	56	43	none	
138	35	56	47	none	
Motobecane—all black					
134	36	55	43	none	Original equipment on Motobecane until '74, used with Solida cranks.
136	35	56	45	none	Original equipment on Motobecane from '74 until present, used with Solida and Nervar cranks.
138	35	56	47	none	For Nervar cranks on Gitane and other French bikes.
Peugeot*—black ends, unpolished middle, polished left and right sides					
140	42	55	43	none	
142	42	55	45	none	Original equipment to fit folder
145	43	55	47	none	Original equipment to fit U08, A08, A018, U018C
RFG—marked RFG					
135	37	54	44	135 54C	
137	37	54	46	137 54C	
140	40	54	46	140 54C	
135	(see note)			68 135	Original equipment on Sutter and other French bikes. Balls run in grooves on axle, cups are extra thick and not interchangeable with others.

*Peugeot axles and cups are not interchangeable with others.

BOTTOM BRACKETS

ASSORTED OTHER COTTERED AXLES

	mark on axle	overall length	left	center	right
German (not interchangeable with others)					
RFG	170	135	36	56	43
Steyr (Puch)	none	142*	40	56	46
	none	135**	38	56	41
Italian					
Magistroni	Magistroni 5R	127	33	56	38
Ofmega	Made in Italy	137	44	58	35
RFG	136	136	36	57	43
Japanese					
(Unknown brand)	No. 1	145	41	51	43
	S	139	40	53	46
	S3	146	42	53	51
	U3	143	41	53	49
	ST	143	41	54	47
	LB	139	35	55	49
	ITAZAM	135	35	55	45
	57	138	35	57	46
	A-8***	140	33	62	43

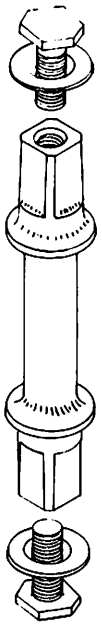
*for Clubman and 10 Speeds
**for 1 and 3 speeds
***similar to Raleigh A-8

BOTTOM BRACKETS

TYPE I BOTTOM BRACKET INTERCHANGEABILITY

The following charts are for replacing worn axles, cups, or complete bottom bracket sets. By comparing the numbers listed, you will be able to determine the differences that affect the fit of the parts.

➡ This should be regarded as an experimental system which will work when used with care. Please write and tell us if you have any problems. We are not and cannot be responsible for any difficulties arising from the use of this chart. Manufacturers do occasionally change specifications without changing model names and numbers. Measurements also vary from batch to batch because of manufacturing tolerances. The parts we measured may not be representative, but we feel the numbers here are close enough to be useful.



Type I axles

HOW TO USE THE BOTTOM BRACKET CHARTS

➡ 1. Read through completely before starting to disassemble the bottom bracket and cranks.
2. Examine the bicycle. Determine how much the position of the chainwheels can be changed. Will the chainwheels rub against the chainstays if they are moved in? Will the derailleur work if the chainwheels are farther out? Estimate in millimeters how much the chainwheels can go in or out. Write down your estimate.
3. Note the position of the lockring on the adjustable cup. How many threads are showing? Write down the number. Estimate how many more or less threads will work. Write it down.
4. Disassemble the cranks and bottom bracket set. Determine what parts need replacing. Then go to the correct chart:
   A. Replacing Axles Only
   B. Replacing Complete Bottom Bracket Set Only
   C. Replacing Cups Only

Once you understand how to use the charts, it is possible to use them for other combinations of replacements. This will, however, increase the possibility that the combinations you select will not work.

➡ NOTE: For all charts, a difference of 1 in the factor indicates a difference of 1mm.

BOTTOM BRACKETS

CHART A — REPLACING AXLE ONLY

5. Look up the Axle Center Width Factor for the axle to be replaced. Note which axles have a similar factor. Axles with a larger factor will leave more threads for the adjustable cup lockring. Axles with a smaller factor will leave less threads. A difference of one in the factor will make a difference of one thread (1 millimeter) on the adjustable cup.
6. Look up the Axle End Factor for the set to be replaced. Axles with similar end factors will have similar chainwheel positions. A larger factor will move the chainwheels away from the frame. A smaller one will move the chainwheels in toward the frame.
7. Compare the factors of the axle to be replaced and the new axle you select. Write down the differences in the axle center width factors and the axle end factors.
8. See if the combination you want to try is in the section "Combinations That Don't Work".
9. Compare the differences to the estimates you made in steps 3 and 4.
10. Tighten the crank on the axle before installing it on the bicycle to check the fit. (see page 2-3.)

Example: Replacing a Nervar 117 with a Campagnolo 70 SS 120 X3Z. Comparing the center width factors:

Nervar 117	75.5
Campagnolo 70 SS 120 X3Z	77.5

The difference of 2 indicates 2 more threads will show on the adjustable cup.

Comparing axle end factors:

Nervar 117	8.5
Campagnolo 70 SS 120 X3Z	9.0

The difference of .5 indicates the chainwheels will be moved out .5 millimeters.

CHART B—REPLACING COMPLETE BOTTOM BRACKET SET ONLY

(Using same brand and model parts for axle, fixed cup and adjustable cup)

5. Look up the Center Width Factor of the bottom bracket set to be replaced. Note which sets have a similar factor. Sets with a larger factor will be wider when measured across the outside faces of the cups. Axles that have smaller factors will be narrower. This will affect the number of threads the lockring will screw onto.

(cont.)

		CHART A AXLE ONLY		CHART B COMPLETE BOTTOM BRACKET SET ONLY					
				English		French		Italian	
	No. on Axle	Center width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor
Campagnolo Sport Double (Road)*	68 SS 120	74.5	8.5	67.5	8.5	68.0	8.0	67.5	8.0
Campagnolo Record Single (Track)*	65 P 110Z	72.0	2.0	65.0	2.0	65.5	2.0	65.0	2.0
	68 P 110Z	75.0	1.5	68.0	1.5	69.0	1.0	68.5	1.0
	68 P 120Z	75.0	3.0	68.0	3.0	68.5	2.5	68.0	2.5
	70 P 120Z	77.0	2.0	70.0	2.0	70.5	1.5	70.5	1.5
Double (Road)*	68 SS 120Z	74.5	6.0	67.5	6.0	68.0	5.5	68.0	5.5
	70 SS 120Z	77.0	5.0	70.0	5.0	70.5	4.5	70.0	4.5
	74 SSS 120	81.0	3.0	74.0	3.0	74.5	3.0	74.0	3.0
Triple*	68 SS 120 X3 Z	75.5	10.0	68.0	10.0	69.0	9.5	68.5	9.5
	70 SS 120 X3 Z	77.5	9.0	70.5	9.0	71.0	9.0	70.5	9.0
Campagnolo Nuovo Record*+ Double (Road)	68 SS 120	70.5	8.5	67.5	6.5	68.5	6.0	67.5	6.5
	70 SS 120	72.5	8.0	69.5	6.0	70.5	5.5	69.5	5.5

*In 1978 Campagnolo crank arms were modified. The axles were also modified to adapt to this change. Axles with the marking +1.0 - +1.5 are 1.0 millimeter longer on the left side and 1.5 mm longer on the right side. Axles with this marking have an axle end factor of 1.5 more. For example, a Nuovo Record 68 SS 120 +1.0-+1.5 has an axle end factor for Complete English Bottom Bracket Set of 7.5 (6.0 from chart plus 1.5).

+Super Record axles have pressed on bearing races and use 3/16" balls. The axle only is not interchangeable with anything else. As a complete Bottom Bracket Set however it has exactly the same dimensions as the corresponding Nuovo Record.

		CHART A AXLE ONLY		CHART B COMPLETE BOTTOM BRACKET SET ONLY					
				English		French		Italian	
	No. on Axle	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor
Nervar									
Single	115	76.0	7.5	69.5	7.5	69.5	7.0	—	—
Double (5 pin)	117	75.5	8.5	69.0	8.0	69.0	8.0	—	—
Double (3,5 arm)	121	76.0	12.0	69.0	12.0	69.0	12.0	—	—
Shimano Dura Ace									
Single (Track)	68 W 107	Not Interchangeable with others		68.0	2.0	68.5	2.0	68.5	1.5
	70 W 109			70.0	1.5	70.5	1.5	70.0	1.0
Double (Road)	68 W 112			68.0	6.5	68.5	6.5	68.5	6.0
	70 W 113			70.0	6.0	70.5	6.0	70.0	5.5
Stronglight									
Single (Track)	113	78.0	5.0	70.0	5.0	69.5	5.0	71.0	5.0
Double (w/5 pin cranks)	118	77.0	8.0	69.0	8.0	68.5	8.5	70.0	8.0
Double (w/5 arm cranks)	120	76.0	10.0	68.0	10.0	67.5	10.5	69.0	10.0
	123	77.0	13.0	68.5	13.5	68.5	13.5	70.0	13.0
Triple	125	77.0	15.5	68.5	15.5	68.5	16.0	70.0	15.5
Tandems	130	77.0	20.0	68.5	20.0	68.5	20.5	70.0	20.0
SR (Sakae Ringyo)									
Single	T-68-S	71.0	5.0	66.5	2.5	66.5	3.5		
Double	R-68	71.0	9.5	66.5	7.5	66.5	8.0		
	R-70	73.0	7.5	68.5	5.5	68.5	6.0	69.5	5.5
Triple	R-68-T	71.0	16.0	66.5	14.0	66.5	14.5		

SUTHERLAND'S HANDBOOK FOR BICYCLE MECHANICS

		CHART A AXLE ONLY		CHART B COMPLETE BOTTOM BRACKET SET ONLY					
				English		French		Italian	
	No. on Axle	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor	Center Width Factor	Axle End Factor
Sugino Mighty									
Single (Track)	MS 68	71.0	4.0	67.5	1.5	68.0	2.0	67.5	1.5
Double (Road)	MW 68	71.0	9.5	67.5	7.0	68.0	7.5	67.5	7.0
	MW 70	73.0	7.5	69.5	5.5	70.0	5.5	69.5	5.5
Triple	MT 68	71.0	13.5	67.5	11.0	68.0	11.5	67.5	11.0
	MT 70	73.0	11.5	69.5	9.5	70.0	9.5	69.5	9.5
Sugino Maxy Bolt Type see page 3-16									
TA, Tevano									
Single (Track)	314	76.0	6.5	69.5	6.0	69.0	6.5	71.0	5.0
Double	344	76.0	9.5	69.0	9.0	68.5	9.5	70.5	8.0
	373	75.0	14.0	68.5	13.0	68.0	13.5	70.0	12.5
Triple	374	75.5	16.0	69.0	15.0	68.5	15.5	70.5	14.5
Zeus									
Single (Track)	109 x 55P	75.0	0.5	68.0	0.5	68.5	0.0	68.0	0.5
	109 x 57P	77.0	-0.5	70.0	-0.5	70.5	-1.0	70.0	-0.5
Double (Road)	114 x 55C	75.0	5.0	68.0	5.0	68.5	4.5	68.0	5.0
	114 x 57C	77.0	4.0	70.0	4.0	70.5	3.5	70.0	4.0
	118 x 55C	75.0	9.0	68.0	9.0	68.5	8.5	68.0	9.0
	118 x 57C	77.0	8.0	70.0	8.0	70.5	7.5	70.0	8.0
Triple	123 x 55T	75.0	14.0	68.0	14.0	68.5	13.5	68.0	14.0
	123 x 57T	77.0	13.0	70.0	13.0	70.5	12.5	70.0	13.0

COMBINATIONS THAT DON'T WORK

- Stronglight cranks—bottom on the ends of the flat on most axles except Stronglight, TA and Phil axles.
- TA cranks—crank bolt face comes close to being flush with the end of many axles.
- Ofmega axles should be used only with Ofmega cranks.
- Shimano axles do not interchange with others. The whole bottom bracket set does interchange.

— NOTES —

PHIL BOTTOM BRACKET AXLES

	length	axle end factor
No. 1	108	2.5
No. 2	113	6.5
No. 3	119	10.0
No. 4	125	16.0

Phil Brackets may be moved right or left several millimeters. This will alter the effective axle end factor by the amount moved.

BOTTOM BRACKETS

CHART B (cont.)

6. Look up the Axle End Factor for the set to be replaced. Choose a set with a similar factor. A larger factor will move the chainwheels away from the frame. A smaller factor will move the chainwheels in.
7. Compare the factors of the bottom bracket set to be replaced and the new set you select. Write down the differences in both the center width factor and the axle end factors.
8. See if the combination you want to try is in the section "Combinations That Don't Work".
9. Compare the differences in factors to the estimates you made in steps 2 and 3.
10. Tighten the crank on the axle before installing it on the bicycle to check the fit (see paragraph on fit between crank arms and axle page 2-3).

Example: Replacing an SR (Sakae Singyo) R68 Complete Bottom Bracket Set with a Sugino MW 68.
Comparing the Center Width Factors:

SR (Sakae Ringyo) R68	66.5
Sugino MW68	67.5

The difference of 1.0 indicates 1 more thread will show the lockrings removed. Comparing the Axle End Factors:

SR (Sakae Ringyo) R68	7.5
Sugino MW68	7.0

The difference of 0.5 indicates the chainwheels will be moved 0.5 millimeters closer to the frame.

CHART C—REPLACING FIXED (right) CUP ONLY

5. Look up the Fixed Cup Factor for the cup to be replaced.
6. Find a cup with a similar factor to replace it with. If the factor is larger, the cup will be "thicker", the chainwheels will be closer to the frame and more threads will show on the adjustable cup.
7. Compare the differences in factors to the estimates you made in steps 2 and 3.

Example: For English cups replacing a Sugino Mighty cup with a Stronglight cup.

Sugino Mighty	4.0
Stronglight	2.0

This 2.0 difference will move the chainwheels 2.0mm closer to the frame. It will also make 2 more threads (2mm) show on the adjustable cup.

BOTTOM BRACKETS

REPLACING ADJUSTABLE CUPS

Adjustable cups are similar in thickness to fixed cups. A thicker adjustable cup may be substituted when the center width change indicates too few threads for the lockring to thread onto. A thinner cup may be used when the center width change indicates too many threads are showing (or simply use a thicker lockring if looks are that important).

SPACERS FOR FIXED CUPS

Cluster spacers or Sturmey Archer spacers work well to move the axle end out or make the bottom bracket shell wider. Make sure you have enough threads for the lockring. This does not work for Italian bottom brackets.

CAMPAGNOLO CUPS AND AXLES

Record Cups are used with axles for track (except Super Record), Cyclo Cross, Sport, triple chainwheels and Record Double.

Nuovo Record Cups are used only with Nuovo Record axles. Nuovo Record axle bearing shoulders are closer together than axles used with conventional cups.

Super Record Cups used 14-3/16 balls and are not interchangeable with others.

Spindle Center Widths	Shell Widths	
	68	70
Record	54.5	56.5
Nuovo Record	49.5	51.5

CHART C FIXED CUP FACTORS

Make	**English**	**French**	**Italian**	**Lockring Thickness**
Campagnolo				
Record	2.0	2.5	2.5	3.0
Nuovo Record	4.0	4.5	4.0	3.0
Nervar	2.5	2.5	-	3.0
Ofmega				
cadmium plated	-	-	3.0	2.5-4.0
chrome plated	-	-	3.0	4.0
Shimano Dura Ace	1.5	1.5	1.5	3.5
Stronglight	2.0	1.5	2.0	4.0
SR (Sakae Ringyo)	3.5	3.5	-	3.5
Sugino				
Maxy	4.5	4.0	4.5	3.5
Mighty	4.0	4.0	4.0	3.5
TA	2.5	2.0	3.0	5.0
Tange	1.5	-	-	3.5
TDC	3.0	-	-	3.5
Zeus	-	-	2.0	-

BOTTOM BRACKETS

TYPE II AND TYPE I MAXY COTTERLESS AXLES

Type II Bottom Bracket Axles have stamped numbers and letters on them which are consistent enough, even between makers, that their dimensions can be listed. Left sides can vary between makers.

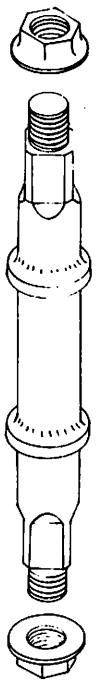
TAPER ON AXLE END

There are two different tapers commonly used on Type II axles—2° and 3°. They can be distinguished by their different stampings and numbers.

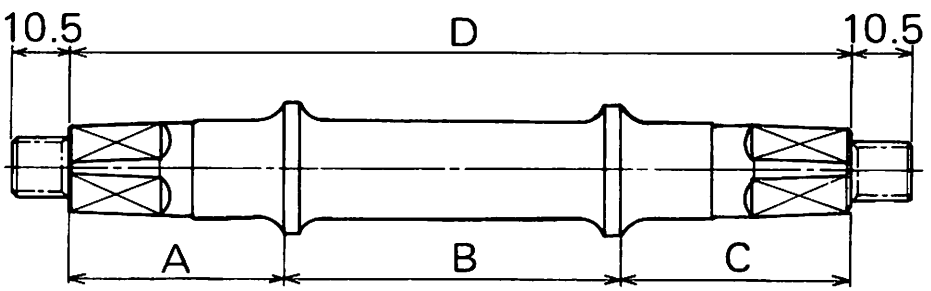
BOTTOM BRACKET SHELL WIDTH

The single digit number stamped on the axle frequently indicates the shell width it is to be used with. 3 is for 68mm bracket shells and 52mm axle centers. 5 is used for 71mm shells and 55mm axle centers. 2 indicates a 50.5mm center.

Cup thickness varies, so it may be possible to use an axle with a 55mm center with extra thin cups in a 68mm bracket, or an axle with a 52mm center with extra thick cups in a 71mm bracket.



Type II



2° SERIES

For Shell Width	Type II (Nut Type) Marking	Type I (Bolt Type) Marking	(Old Marking)	A	B	C	D
	68S			32	50.5	32.5	115
	68K			32	50.5	36	118.5
	2S			32	50.5	37.5	120
	2R			32	50.5	42	124.5
68mm			68-S	31	52	30	114
		D-3L		32	52	32	116
	3P	D-3P		32	52	35	119
	3N	3N-B	68-W	32	52	36	120
	3SS	D-3SS		32	52	37.5	121.5
	3S, (3S), 3S2*			35	52	37.5	124.5
	3T	3T-B		35	52	39	126
			68-T	32	52	40.5	124.5
	3U	3U-B		35	52	40.5	127.5
	3R			35	52	42	129

2° SERIES

For Shell Width	Type II (Nut Type) Marking	Type I (Bolt Type) Marking	(Old Marking)	A	B	C	D
70mm	5P	D-5P		30.5	55	33.5	119
			70-W	32	55	34	121
	5N	5N-B		32	55	35	122
	5SB			32	55	36	123
	5SP	D-5SP		30.5	55	37.5	121
	5SS			32	55	37.5	124.5
		5S-B		32	55	37.5	124.5
	5S, (5S)			35	55	37.5	127.5
			70-T	32	55	38.5	125.5
	5T			35	55	39	129
		5U-B		32	55	40.5	127.5
	5U			35	55	40.5	130.5
	5R			35	55	42	132

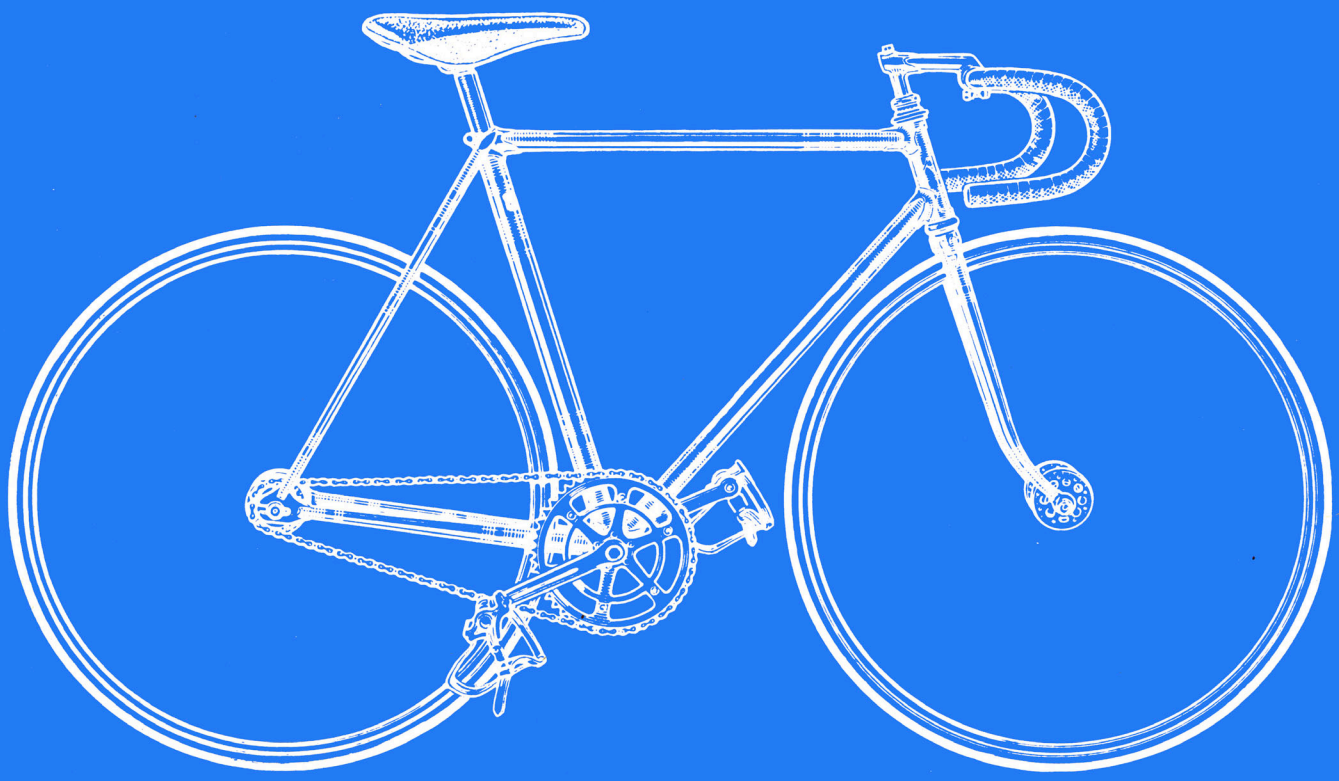
3° SERIES

68mm	UNIT	36.0	50.5	43.0	129.5
	3S, 3S3*	37.5	52	40	129.5
	3K	37.5	52	41.5	131
	3H	37.5	52	43	132.5
	3F	37.5	52	44.5	134
70mm	5K, 5M	36.0	55	40.0	131
	5H	36.0	55	41.5	132.5
	5F	36.0	55	43.0	134

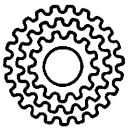
*It's easy to confuse axles marked with 3S or (3S). The parentheses sometimes indicates 2°.

—NOTES—

Freewheels
Fixed Gears
Derailleurs



FREEWHEELS, FIXED GEARS



MULTI-SPEED FREEWHEEL—HUB SHELL

BALL SIZES 1/8"

Counting freewheel balls is a waste of time. It is better to use one or two too few balls than too many.

THREAD SIZES

English	1.370" x 24 TPI (34.80mm x 1.058mm)
French	34.7mm x 1mm (1.366" x 25.4 TPI)
Italian	35mm x 24 TPI (1.378" x 1.058mm)

Country of manufacture does not indicate thread dimensions.

Most freewheels imported into this country have English threads. English, Japanese, and USA bicycles generally come with English threaded freewheels. French bicycles generally come with French threaded freewheels, however recent Peugeots and some others use English threaded freewheels. Italian bicycles generally use Italian threaded freewheels.

Stop and measure before forcing a freewheel.

A check with a thread pitch gauge will separate French from Italian and English threads. English and Italian hub threads can be distinguished by measuring with a vernier caliper. A 2" micrometer is, however, the preferred tool. This method may not work on some hubs.

FREEWHEEL INTERCHANGEABILITY

	English hub	French hub	Italian hub
English Freewheel	A	C*	B**
French Freewheel	C*	A	C*
Italian Freewheel	B**	C*	A

*Difference in thread pitch makes this combination unacceptable.

**This combination works, but avoid changing back and forth between Italian and English freewheels. Not for strong or heavy riders.

Class of Fit

A Made to fit.
B Will fit and be serviceable but will damage threads slightly.
C Looks like it might work but won't.

FREEWHEELS, FIXED GEARS

MARKINGS ON FREEWHEEL BODIES

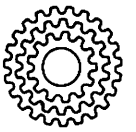
ID Markings on freewheel bodies are only found on more recent models.

Atom	
English	rectangular punch mark on back of body
French	no mark
Maeda	
English	no mark
French	M stamped in inner ring of body on outside
Maillard—see Atom	
Normandy—see Atom	
Regina	
English	F.I. stamped in back
French	F.F. stamped in back
Italian	nothing stamped in back
Zeus	
English	B stamped in back
French	M stamped in back

ID MARKINGS ON HUBS

Zeus	
English	B.S.C. stamped on center shaft of the hub
French	nothing stamped on center shaft of the hub

FREEWHEELS, FIXED GEARS



FREEWHEEL SPACERS

Campagnolo	1, 1.5, 2mm
Sturmey Archer HMW127	1/16" (1.6mm)
Raleigh	1/32" (.8mm), 1/8" (3.2mm)
Cyclo (French)	1.2, 1.7mm

MOUNTING FREEWHEELS

FACTORS TO CONSIDER

1. Hole in freewheel has to be large enough to fit over locknuts of hub.
2. Before you put it on, make sure you can get it off. See "Problems to Avoid."
3. Match the threads with the hub.
4. Be aware of any chainline changes. Note the offset differences on the freewheel back. Also see hub section page 6-2.
5. Check outside clearance, especially clusters with outside chainguard. Will they clear seat stay, chain stay and derailleur mounting bolt?
6. Be sure faces of freewheel and hub that butt together are compatible, i.e. Regina Scalare (close ratio) has recessed face that may not butt properly on some hubs.
7. Is a new chain necessary?

PROBLEMS TO AVOID

Don't use an old style Shimano splined freewheel on Campagnolo, Shimano Dura Ace or similar hub. It comes off only after removing axle from other side.

Mount splined Atom, Zeus, or Regina to a Campagnolo or similar hub only if you have a Phil tool.

Before installing a freewheel on a sealed bearing hub, be sure you can get it off. Atom-type splined freewheels can only be removed with a Phil remover or by disassembly.

Old style Shimano splined freewheels must be disassembled to be removed from Phil, Hi-E, Weyless, and other sealed bearing hubs.

Always remove the freewheel before cutting the spokes out of a wheel.

12mm tandem axles are too big for the holes in many freewheel pullers. Current Bicycle Research tools have clearance for 12mm axles.

FREEWHEELS, FIXED GEARS

REMOVING FREEWHEELS

FACTORS TO CONSIDER

Fit for notch tools

1. Tool must be in good shape.
2. Dogs must closely fit notches.
3. Tool must butt against body, not bottom of notch.
4. Tool must be properly located against body or axle or both, to ensure the dogs stay properly engaged when force is applied.
5. Tool *must* be secured with quick release or axle nut to break freewheels loose.
6. With remover clamped in a vise, press down at rim while turning to remove.

Dogs that are too long prevent the rim from seating on the body. This allows the remover to rock and the dogs to climb up and strip the body.

If stripped, chisel off the chewed-up part on a Regina notched-type freewheel. Often it will chip off square. Then start again.

Current Bicycle Research tools all have clearance for 12mm tandem axles.

FREEWHEEL REMOVING TOOLS

Combinations of freewheels and pullers are listed as "A", "B", or "B-". An "A" fit is probably the most successful combination and, if properly secured and located, won't result in any damage to the freewheel or tool. With a "B" fit there is some chance of damage to the freewheel and tool. A "B-" fit is more likely to damage both tool and freewheel; but if you have to remove freewheel to throw it out, it might be worth it.

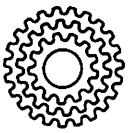
Not all combinations that work are listed. If you try others, be sure to follow the recommendations listed under "Factors to Consider."

If all else fails, you can remove a freewheel by dismantling it. Exceptions to this are the old style Winner.

MARKINGS ON VAR TOOLS WITH QUICK RELEASE THREADS

see page 11-4

FREEWHEELS, FIXED GEARS



FREEWHEEL REMOVING TOOLS

MULTI-SPEED FREEWHEELS

Make of Freewheel	Class of fit—Tool	Notes
Atom-notched	B Var 01 Var 186 B- Bicycle Research Regina	
—splined	A Atom splined Bicycle Research Atom Phil Tool Var 407 Zeus splined	With Phil Tool, removing axle spacers is not necessary. Be sure tool is well seated. Keep a sawed-off one for hubs that don't allow tool to fully seat. Atom-style splined removers are not all the same size due to tolerances. Keep several around to match different freewheels. Too loose a fit or one that doesn't go in all the way can cause trouble.
Caimi-Everest	B Bicycle Research Regina Campagnolo Shimano Dura Ace (new style)	
Cyclo (English)	A Cyclo (English)	French and English Cyclo are completely different.
Cyclo (French)— 64, 72 and Competition	A Cyclo (French) DR.64 B Kingsbridge Var 188	Cyclo (French) tools will fit over the large locknuts found on New Star hubs. English and French Cyclos are completely different.
Cyclo-Pans (French)	A Use tool that comes with the freewheel DR.68, DR.P	
Maeda—SunTour Pro Compe, 8.8.8. and Winner (2 notch)	A Bicycle Research SunTour A SunTour (2 dog) B Cyclo (English) some B- Maillard 700 Shimano Dura Ace (old style) Var 413	Use real SunTour tool or Bicycle Research. Can be used without removing locknuts and without quick release or axle nuts to hold it in place. Use vise and press down at rim while turning. Bicycle Research tool has clearance for 12mm tandem axle.
(4 notch)	A SunTour (4 dog)	
Maillard—splined —notched (700)	see Atom splined A Maillard 411 & 413 Var 413 B- Shimano Dura Ace (old style) Var 186	413 has special skewer

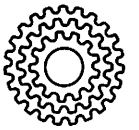
FREEWHEELS, FIXED GEARS

FREEWHEEL REMOVING TOOLS (cont.)

Make of Freewheel	Class of fit—Tool	Notes
Merveille	A Eldi BGM Var 187 Linden	Threads that mate with the hub go straight through. You have to remove the two smallest sprockets before you see the name plate.
	B- Regina single-speed remover Var 01	Remove the two smallest sprockets before using the Eldi tool. Var 01 may have to be filed slightly to match.
Milremo—splined —Pans —2 notch	see Atom splined see Cyclo Pans see Atom notched	
Normandy	A Bicycle Research Normandy Var 405	
Regina—notched	A Bicycle Research Regina Campagnolo Shimano Dura Ace (new style) B- Cyclo (English) some Kingsbridge Var 01 Var 186 Var 188	Campagnolo adaptor for 13 tooth cogs and 6 speeds lack the ring that prevents sideways slippage. The standard remover can be modified to fit a freewheel with 13 teeth by grinding off the outside dogs. This modification means you can't turn the remover block over when it becomes worn or use it for single speed sprockets. New Bicycle Research fits 12 tooth Regina.
—splined	see Atom splined	
Schwinn Approved	See Atom splined or Shimano splined for small diameter internal-splined cogs. See Normandy for large diameter internal-splined cogs. See SunTour or Atom for notched cogs.	
Shimano—Automatic	A Shimano Automatic	Freewheel must be partly dismantled before removal. Reassembly is easy.
—old style splined A Type	A Bicycle Research Shimano Shimano A type Var 411	Tool outside diameter 20.1mm. Shimano old style splined freewheel will not fit on a Shimano Dura Ace hub. A 17mm hex locknut will just fit through the splines in an old style splined freewheel.
—new style splined B-type	A Bicycle Research Shimano UG Shimano B type	Tool outside diameter 22.6mm. Removing axle spacers is not necessary.
—Freehub except Dura Ace EX	A Shimano Freehub removal tool	

FREEWHEELS, FIXED GEARS

FREEWHEEL REMOVING TOOLS (cont.)



Make of freewheel	Class of fit—Tool	Notes
—Freehub Dura Ace EX	A Shimano Freehub removal tool for Dura Ace EX	
—FF System Friction Freewheel	A Shimano Type A	Remove outer locknut and spacers to gain access to splines.
—Dura Ace old style	B Shimano Dura Ace old style B- Var 186	Old style has flush surface (threaded flange doesn't protrude above the freewheel's adjusting cone).
—Dura Ace new style, 600	A Bicycle Research Regina Shimano Dura Ace (new style) B- Cyclo (English) Kingsbridge Var 188	On new style freewheels the threaded flange protrudes above adjusting cone face, similar to a Regina freewheel. Shimano Dura Ace old and new style freewheel tools are not interchangeable. Be sure to use the correct one. Tighten it down extra snug. New style has ring to locate tool on body. Old style tool has two dogs.
Simplex	A Bicycle Research Regina Campagnolo Shimano Dura Ace (new style) B- Cyclo (English) Shimano Dura Ace (old style) Var 01 Var 186 Var 188	
TDC—3 notch	A Bicycle Research TDC TDC Var 402	
—4 notch	A Bicycle Research TDC TDC Var 402 B Var 01 Var 186	
Zeus 2000	A Bicycle Research Atom Phil Tool Var 401 Var 407 Zeus splined	Var lists a notch tool #401 for the Zeus 2000. See notes under Atom. Notch tools are perfectly safe if they fit and are often more convenient than gaining access to the splines.

FREEWHEELS

SINGLE SPEED FREEWHEEL THREADS

Most single speed freewheels use the same threads as multispeed freewheels (see page 4-1). Exceptions are as follows.

French Juvenile	32mm x 1.0mm
Sun Tour BMX and mini size	30mm x 1.0mm

SINGLE SPEED FREEWHEEL REMOVERS

Atom-Maillard	A Var 412
Cyclo 103 & 303 (French)	A DR.SD
Everest	A Campagnolo
Merveille	A Var 187 Linden B Eldi Regina
Regina	A Regina B Campagnolo (may need a bit of grinding) Eldi
Shimano	A Shimano Freewheel and Freehub A removal tool
Sun Tour regular	A Sun Tour Single freewheel removal tool.
Sun Tour EZ OFF 4 hole	A Sun Tour EZ OFF 4 Dog tool
TDC	B Eldi Regina

FIXED GEAR—HUB SHELL

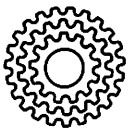
Fixed gear hubs have a left-threaded lockring to secure sprocket. Thread sizes of fixed gear sprockets are the same as those used for freewheels.

Thread sizes of lockrings may vary from maker to maker. A maker will usually use one lockring size for all hubs, even though the sprocket thread is different. This is true of Campagnolo and Zeus.

Sprocket Lockring Threads

Campagnolo	1.32" x 24 TPI	left threaded
Japan Standard	1.29" x 24 TPI	left threaded
French	33mm x 1.0mm	left threaded

FREEWHEELS



FREEWHEEL SPROCKET INTERCHANGEABILITY

SPROCKET REMOVAL

Most modern freewheels have splined inner sprockets held in place by threaded outer ones. This allows easy removal of all sprockets, even with the freewheel in place. A few manufacturers still make freewheels with all threaded sprockets. One or two of the larger sprockets are left-threaded and remove from the inside; the rest are right threaded and remove from the outside. Do not attempt to hold the bare freewheel body when removing the last threaded sprocket. Instead, thread on two other sprockets and lock them against *each other* (like cone and locknut), not against the freewheel body shoulder. Use this pair of sprockets to hold the freewheel while loosening the last sprocket.

SPROCKET REPLACEMENT

It is usual to replace worn sprockets when installing a new chain because the new chain does not run smoothly on sprockets which have worn to the old chain's longer links. Often only the two outer sprockets need to be replaced.

Inner sprockets with a bevel on one side should be installed with the bevel facing inside, otherwise rough shifting will result.

INTERCHANGEABILITY CHARTS

The charts on the following pages cover sprocket interchangeability for the freewheel models listed below:

Model	Page
Atom	4-12
Campagnolo	4-11
Cyclo (Made in France)	
A	4-16
Competition	4-16
Pans	4-16
3 and 4-Speed	4-16
64	4-16
Cyclo Type B (Made in England)	4-16
Everest	4-11
G. Caimi	4-11
Maillard	
HS	4-11
700	4-11
Normandy	4-12
Regina	
CX	4-11
Normal Body	4-12
Scalare	4-12
3-Speed	4-12
Schwinn Approved	
Model F	4-12
Model F2	4-12
Model F3	4-12
Model J	4-12

Model	Page
Shimano	
A-Type	4-12
B-Type	4-12
Model FC-300	4-12
Dura-Ace Freehub	4-17
Dura-Ace 5 and 6-Speed	4-13
MF 1500	4-12
MF 1501	4-12
MF 1510	4-12
Uniglide	4-12
600 Freehub	4-17
600 5 and 6-Speed	4-13
Sun Tour	
New Winner 5 and 6-Speed Normal	4-14
New Winner 6 and 7-Speed Ultra	4-14
Old Winner 5 and 6-Speed Normal	4-14
Perfect 3 and 4-Speed	4-14
Perfect 5 and 6-Speed Regular	4-14
Perfect 6-Speed Ultra	4-14
Pro-Compe 6-Speed Ultra	4-14
TD Cross	4-12

FREEWHEELS

FREEWHEEL SPROCKET INTERCHANGEABILITY (cont.)

How to Use the Interchangeability Charts

Horizontal rows represent freewheel models and vertical columns represent sprocket positions (1 *inside* to 7 *outside*).

Sprockets inside each outlined box are interchangeable with one another. One-way interchangeability is indicated by an arrow crossing a heavy line ⟶ . Restricted interchangeability is indicated by a dotted arrow ⇢ (if one-way) or by a dotted line ----- (if two-way) and is explained in a lettered footnote.

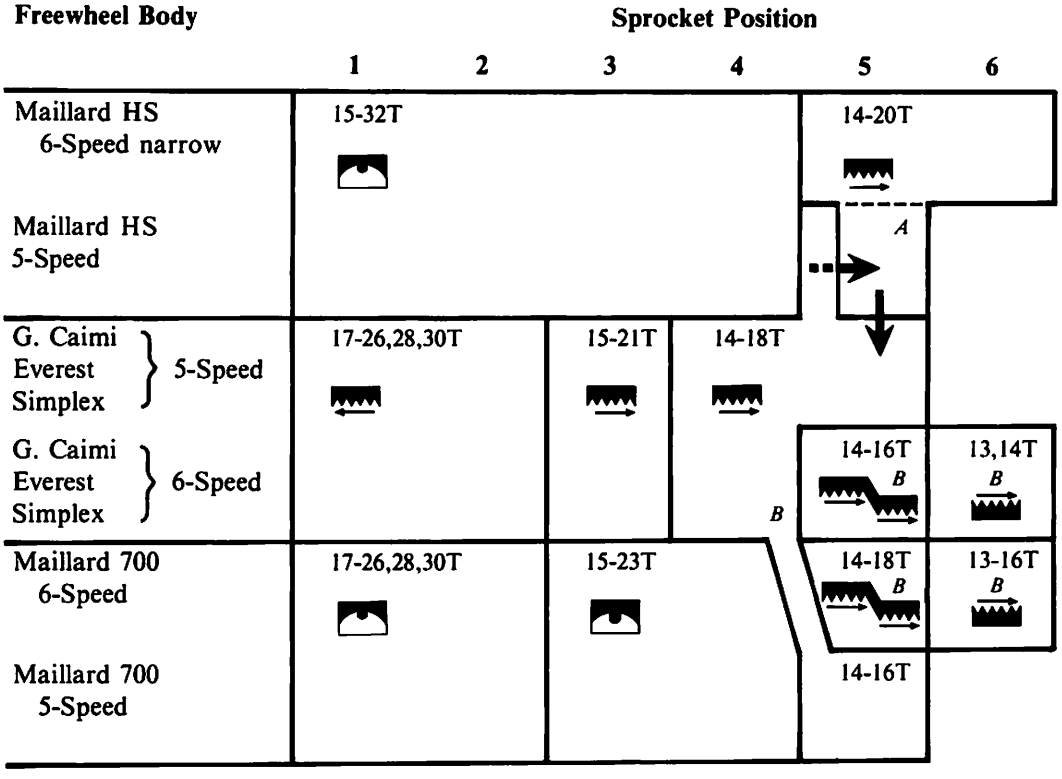
For each sprocket listed, the manner in which it attaches to the cluster is indicated. Also indicated is any provision a sprocket may have to hold the next smaller sprocket. The following symbols are used:

Symbol	To attach to cluster sprocket has:	To accept next-smaller sprocket, sprocket has:
	Splines	
	Inside threads (left-handed)	
	Inside threads (right-handed)	
	Inside threads (right-handed)	Inside threads, same diameter
	Inside threads (right-handed)	Inside threads, lesser diameter
	Outside threads (right-handed)	Inside threads
	Inside threads (right-handed)	Outside threads

Arrow indicates the direction of sprocket *removal.* Note that splined and right-threaded sprockets always come off the right (outside) of the cluster, left-threaded sprockets come off to the left (inside).

FREEWHEELS

MAILLARD, SIMPLEX, G. CAIMI and EVEREST FREEWHEEL SPROCKET INTERCHANGEABILITY

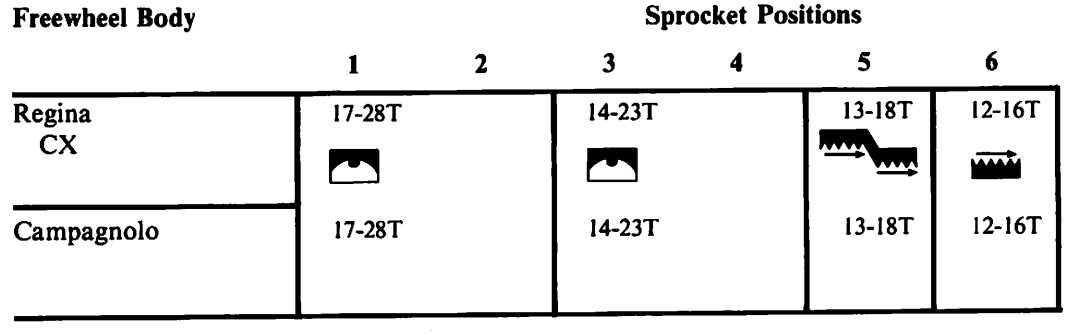


Notes

A. Maillard 700, Simplex, G. Caimi and Everest 5-speed outer sprockets have flanges and may be used on HS 5-speed directly but not on the HS 6-speed. HS 6-speed outer sprockets require Maillard spacer ref. 2261 when used on HS 5-speed.

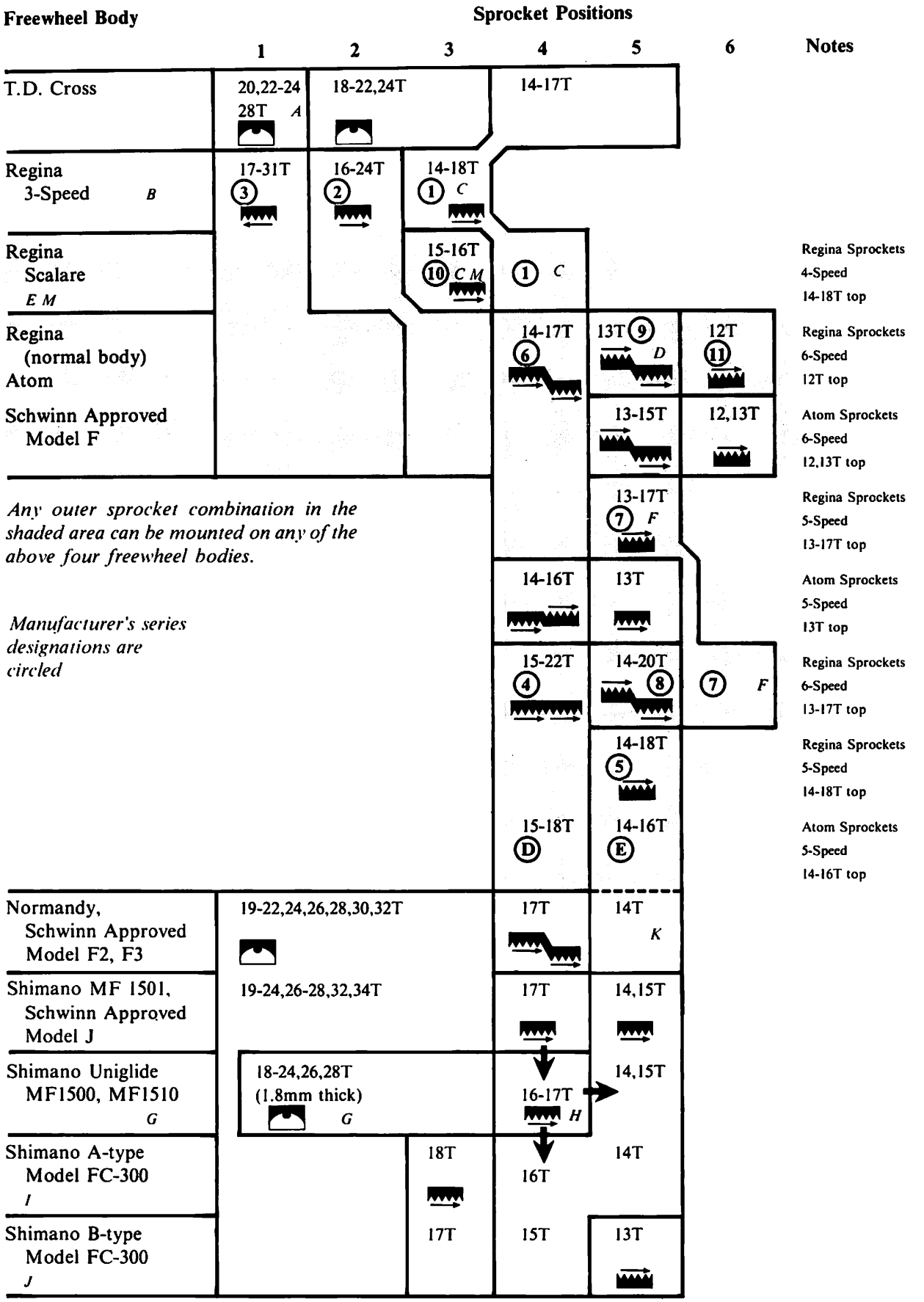
B. Maillard 6-speed outer two sprockets do not interchange with the other 6-speeds because the thread pitch is different. Single sprockets have short enough thread that they work as a class B fit.

REGINA CX, AND CAMPAGNOLO



FREEWHEELS

TD CROSS, REGINA, ATOM, NORMANDY, SHIMANO and SCHWINN APPROVED FREEWHEEL SPROCKET INTERCHANGEABILITY



FREEWHEELS

TD CROSS, REGINA, ATOM, NORMANDY, SHIMANO and SCHWINN APPROVED FREEWHEEL SPROCKET INTERCHANGEABILITY (cont.)

Notes

A. TD Cross #1 sprocket is dished and is not interchangeable with any others, although the spline configuration is the same.

B. Regina 3-speed uses the same sprockets as other Regina freewheels.

C. ① and ⑩ have the same threads but ① is 4.5mm thick with beveled flange while ⑩ is 3.5mm thick with squared flange.

D. New-style ⑨ (threaded as shown) is clearly not interchangeable with old-style ⑨ threaded . Old-style ⑨ is no longer available (see note *M* for its use on Scalare body).

E. Note that Regina Scalare is the only 5-speed that will accept a 15T sprocket in the 3rd position.

F. Regina ⑦ interchanges with Sun Tour Pro-Compe 6-speed outer sprocket.

G. Shimano Uniglide freewheel body lockring is level with outer rim. *Splined* sprockets are thinner and will not lock in place if used on other similar Shimano freewheels.

H. Shimano Uniglide *outer* sprockets may be used on other similar Shimano freewheels if a spacer like the one behind the 4th sprocket is used to the inside of each sprocket. The 16T sprocket requires a special beveled spacer (a bevel may be ground on the standard spacer) to prevent chain interference.

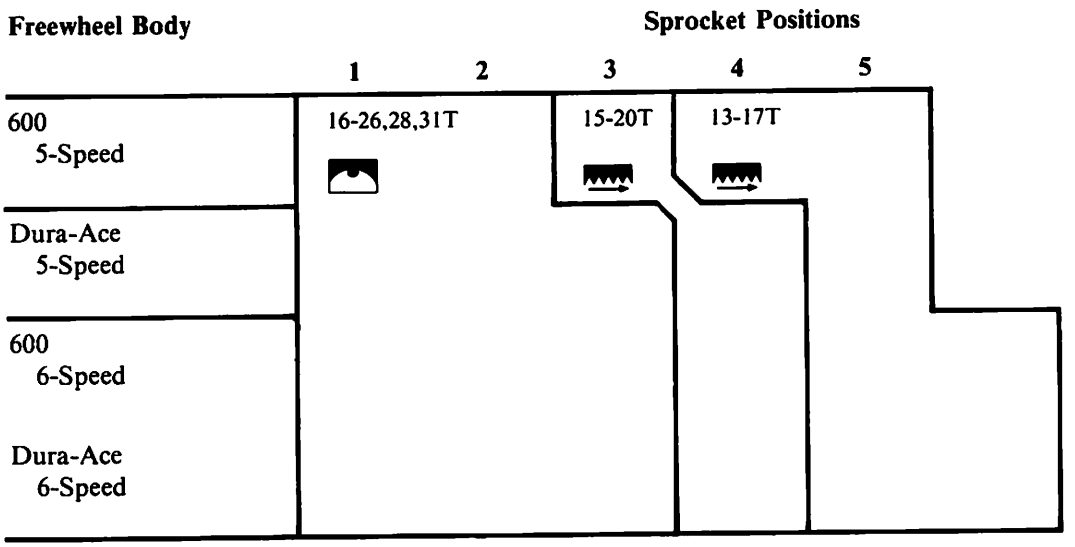
I. Note that Shimano A-type FC-300 has two threaded diameters and one splined diameter.

J. Note that Shimano B-type has outer sprocket threaded into face of body.

K. Schwinn Approved models F2 and F3 outer sprocket has special threads to accept high-gear chain guard; it is otherwise interchangeable with the Regina and Atom sprockets above it.

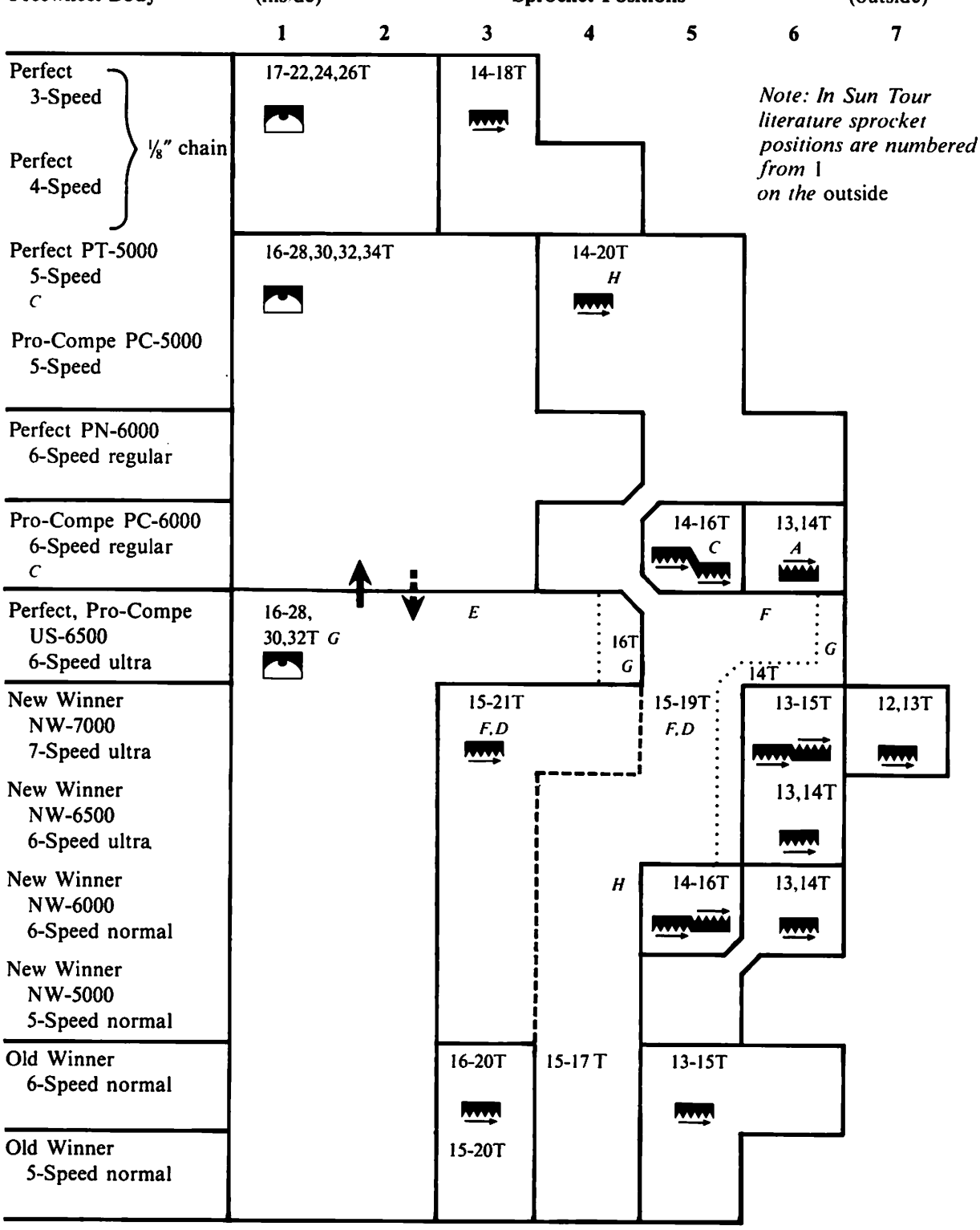
M. In addition to the combinations shown, old-style Scalare freewheels have ① in place of ⑩ and old-style ⑨ in place of ⑥ making a ③②①⑨⑦ five-speed instead of the current ③②⑩⑥⑦.

SHIMANO DURA-ACE AND 600 FREEWHEEL



FREEWHEELS

SUN TOUR SPROCKET INTERCHANGEABILITY



Notes

A. Interchangeable with Regina series (7)

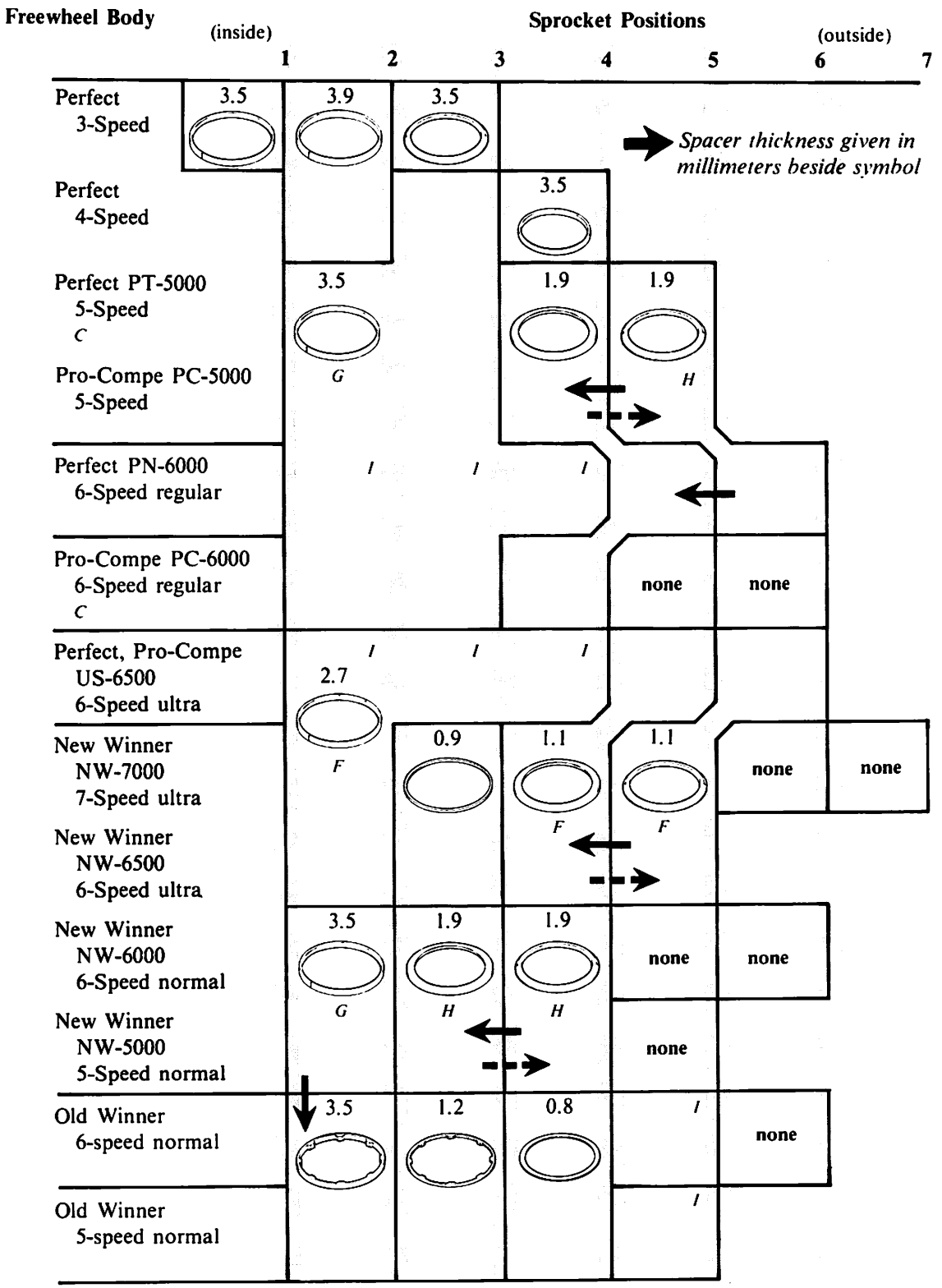
C. Mounting 5-speed sprocket here leaves outer ball race exposed.

D. When moving a sprocket to the right across the dashed line, a bevel must be ground on the right side of the teeth. Sprockets moved to the left will fit regular width Winner, but must have a high flange at the inside to secure Ultra Winner's splined sprockets.

cont. next page

FREEWHEELS

SUN TOUR SPACERS



Notes (cont.)

E. Sprocket dogs must be filed slightly when interchanging downward.

F. 15T sprocket requires *beveled* spacer #15004514.

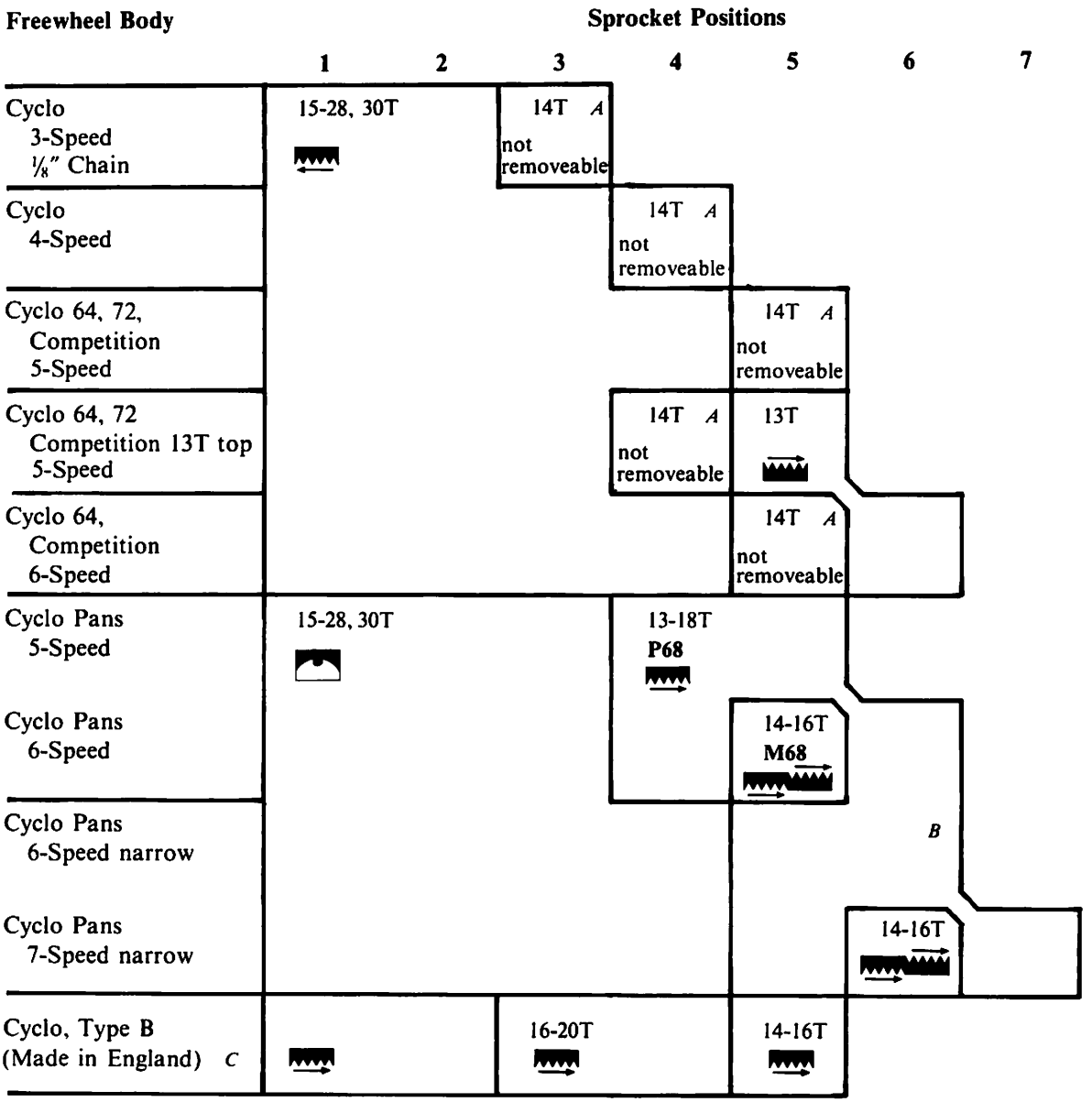
G. Ultra 16T and 14T sprockets have a narrow built-in spacer and fit only Ultra and New Winner bodies.

H. 15T sprocket requires beveled spacer #15004511 or #15004515.

I. Where thin shims are used in addition to standard spacers, they must be replaced exactly as removed.

FREEWHEELS

CYCLO
FREEWHEEL SPROCKET INTERCHANGEABILITY



Notes

A. This sprocket is part of the freewheel body and is *not* removeable. Inner sprockets are left-threaded and unscrew towards the inside.

B. For correct spacing on 6-speed turn outside sprocket over.

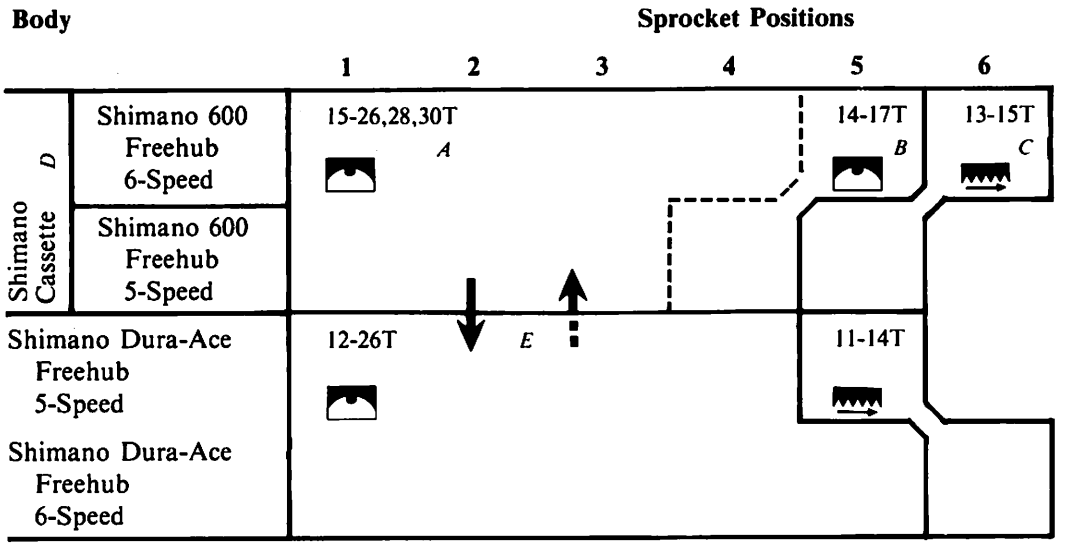
C. Type B Cyclo is made in England and is unrelated to the French Cyclo models listed above it. All sprockets unscrew to the outside. To remove #5, loosen the others, lock #2 and #3 together (like cone and locknut) and loosen #5.

FREEWHEELS

SHIMANO FREEHUB SPROCKET INTERCHANGEABILITY

On all models of Shimano Freehub the freewheel ratchet is built into the hub itself. Freehubs are available in a variety of flange heights and axle lengths.

The splined sprockets of the 600 are bolted together, those of the Cassette are riveted together. Interchanging individual sprockets requires that these assemblies be broken down.



Notes

A. The 30T sprocket is currently available only as part of a riveted assembly for the Cassette, but the rivets may be drilled out and the sprocket used in other assemblies.

B. The three bolt holes in the second-outermost sprocket of the 600 Freehub are *threaded* for the bolts that hold the splined sprockets together. These sprockets may be interchanged freely across the dashed line if no bolts are used.

C. Cassette and 600 Freehub outer sprocket is also interchangeable with Sun Tour New Winner Ultra-Seven outer sprocket, although an extra spacer may be needed when the Sun Tour sprocket is used on the Freehub.

D. The 600 Freehub has bodies of different lengths for 5 and 6-speed versions. Cassette Freehub has one body with long threaded portion for either 5 or 6-speed. This body requires wide dropout spacing (124mm) even when used as 5-speed.

E. Dura-Ace Freehub does not use bolts. Some, but not all, Dura-Ace sprockets have unthreaded bolt holes and may be used as part of a bolted assembly for the 600 Freehub. All Dura-Ace splined sprockets may be used on 600 or Cassette bodies if no bolts or rivets are used.

DERAILLEURS

REAR DERAILLEUR CAPACITY CHART

The capacities given in this chart use the manufacturer's hanger. When installing derailleurs on frames with built-in hangers the capacities may be different.

Maximum Freewheel Size (teeth): the largest freewheel sprocket a derailleur will handle.

Maximum Total Capacity (teeth): the difference between the smallest and largest freewheel sprockets plus the difference between the smallest and largest chainwheel sprockets.

	Maximum Freewheel Size (teeth)	Maximum Total Capacity (teeth)
Campagnolo		
Gran Sport	34	38
Gran Sport GT	34	38
Gran Turismo	34	36
Nuovo Gran Sport	28	26
Nuovo Record	28	24
Rally	36	40
Valentino	28	28
Velox	28	28
Elgin		
American	34	38
Galli		
Competizione	26	22
Sport	26	20
Huret		
Allvit III	30	32
Challenger II	28	32
Duopar	36	38
Eco	28	32
Jubilee 2000 (short cage)	24	30
Success	28	32
ROTO	26	22
Schwinn Approved		
Allvit style	32	32
GT 100	34	34
GT 120 (see Shimano Eagle)		
GT 300 (see Shimano Titlist GS)		
GT 400 (see Shimano Tourney)		
GT 420 (see Shimano 600)		
GT 500	28	30

DERAILLEURS

REAR DERAILLEURS, continued

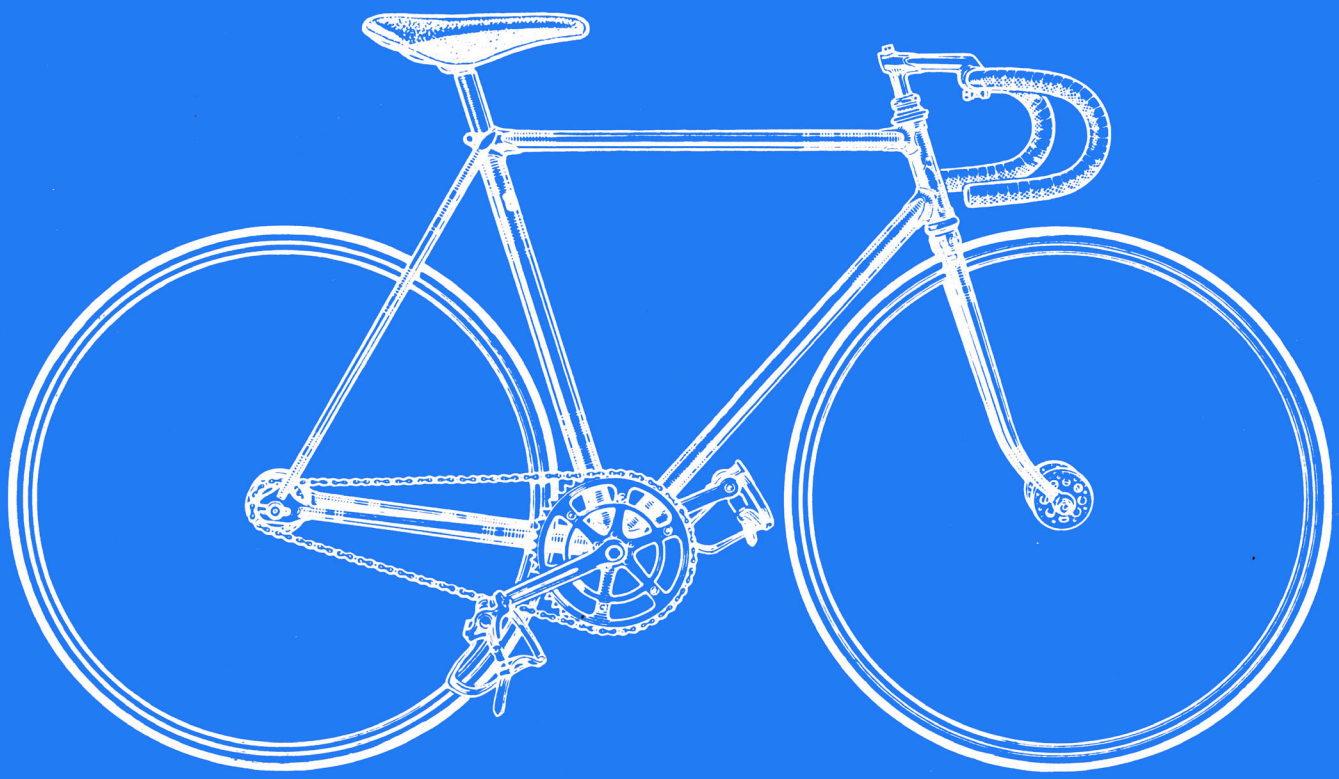
	Maximum Freewheel Size (teeth)	Maximum Total Capacity (teeth)
Shimano		
Altus ST (Long Cage)	34	36
Crane (see Tourney)		
Dura-Ace	26	26
Dura-Ace EX	26	26
Eagle	34	34
Eagle GT	34	38
Eagle II	34	34
Positron	28	28
Titlist	28	28
Titlist GS	34	38
Tourney	28	28
Tourney GS	34	34
500	28	28
500 GS	34	34
600	28	30
600 GS	34	35
600 EX	28	27
600 EX-Long Cage	32	37
RS (Centeron)	30	30
Simplex		
Criterium (with dimpled cage)	30	30
LJ Super 615	30	30
LJ 1000 T	30	30
Maxi (Prestige)	36	39
Prestige 637 (see SX 100T)		
SLJ A 5000 T	30	30
SLJ A 5000 GT	36	39
SX 100 T 637-P	30	30
SX 400 GT	36	40
SX 810 T	30	30
SX 810 GT	36	39

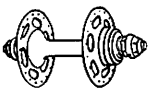
DERAILLEURS

REAR DERAILLEURS, continued

	Maximum Freewheel Size (teeth)	Maximum Total Capacity (teeth)
Sun Tour		
Cyclone	24	26
Cyclone GT	34	40
GT	34	38
Honor	30	30
Seven	30	30
Seven GT	34	38
Skitter	30	28
Superbe	23	22
V	24	26
VGT	34	40
VxS	30	30
VxT	30	28
Vx	26	24
VxT	30	28
Zeus		
2000	26	20
Criterium	26	20

Hubs





INTRODUCTION

HOW TO USE THIS SECTION

When working with a particular hub, follow the procedures under GENERAL NOTES below, then turn to the section devoted to that type of hub. Read the information in the section introduction, then proceed to the trouble chart and disassembly/assembly instructions for that hub.

When disassembling an unfamiliar hub without the aid of drawings, it is a good idea to thread the parts on a wire in the *order* and *orientation* that they were removed. Proceed carefully and note similarities and differences with hubs treated here.

Parts Interchangeability Charts

Charts are provided indicating interchangeability of individual parts between hubs of different models and from different manufacturers. Parts names used are taken from the manufacturer's literature and vary from brand to brand.

Assembly and Disassembly Instructions

Detailed instructions for overhauling most models of coaster brake and internally geared hubs are provided. Note that the assembly and disassembly instructions refer to the same drawings. Disassembly steps are numbered *down* the *left-hand* columns, assembly steps are numbered *up* the *right-hand* columns. Wherever possible, drawings show parts in the order they are to be removed and replaced. The same parts names are used as in the associated parts chart.

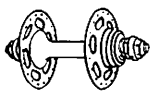
GENERAL NOTES

Chainline

Before removing a single-sprocket rear wheel check the chainline. A straight-edge held against the chainwheel should be parallel with the chain. If it is not, note amount and direction of misalignment so that it can be corrected later. *This test only works if chainwheel is true.* Out-of-true chainwheel will cause excessive wear just as a misaligned chain will.

Axle Nuts and Washers

When working on a wheel be sure to note the position of all axle spacers and nuts. If necessary, thread them on a wire to keep them in order and properly oriented.



HUBS

INTRODUCTION (cont.)

Bearing Adjustment

Proper tools are essential. *Never grip axle threads in steel vise jaws.* Use an axle vise or brass or wood inserts to avoid damaging threads. Where possible grip axle by flats or locknuts. Use cone wrenches on cone and locknut flats; use hook wrenches on the round notched locknuts found on F&S hubs and Sturmey-Archer coaster brakes.

To adjust bearings, hold axle firmly and tighten cone finger tight. Back it off 1/4 turn, hold it with cone wrench, and lock it in place with locknut. Check bearing operation and side play. Axle should turn smoothly between thumb and forefinger; installed wheel should show a trace of side play at the rim. Tighten or loosen 1/8 turn if necessary. Some unthreaded cones have two locknuts. Adjust cone position with the first locknut and lock it in place with the second.

Sprockets, Spacers, Snap Ring and Dust Cap

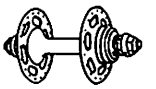
Most sprockets are held on the driver by 3 lugs and a snap ring. To remove a lugged sprocket, pry snap ring loose with a thin bladed screw driver. Place one finger over axle to prevent snap ring from flying off.

Older sprockets are right-threaded and held in place by a left-threaded lockring. To remove threaded sprocket, unscrew lockring *clockwise,* then unscrew sprocket *counter-clockwise* with sprocket tool. On freewheeling hubs without a coaster brake it is necessary to remove the driver to unscrew a threaded sprocket.

Note carefully the orientation of a dished sprocket (dished *in* or dished *out*) and the position of all spacers. Improper chainline can be corrected by rearranging spacers and/or reversing dished sprocket. Misaligned chain will cause excessive wear. For sprocket data see parts charts under the hub type and the Sprocket Interchangeability chart on page 6-3.

Cleaning Parts

Never use gasoline. It is simply too explosive. An enclosed parts cleaning tank is essential for safe and efficient work. Find a supplier under *degreasing equipment* in the Yellow Pages of the phone book. Always clean the outside of the hub shell: it is the only part of the job that anyone will see.



INTRODUCTION (cont.)

INTERCHANGEABLE 3-LUGGED SPROCKETS, SNAP RINGS AND SPACERS

	F & S	Sturmey-Archer	Shimano	NK 3-speed	Sun Tour	Karat (specify flat
Sprockets	(dished 1/8")	(dished 1/16")	(dished 1/8")	(dished 1/16")	(dished 1/16")	or dished 1/8")
12T	see note[3]					170-12[3]
13T	see note[3]	HSL 713	321 0380			170-13[3]
14T	see note[3]	HSL 714	321 0300			170-14[3]
15T	see note[3]	HSL 715	321 0310[2]			170-15
16T	1004 035 000[1]	HSL 716	321 0320	291	40111601	170-16
17T	1004 047 000[1]	HSL 717	321 0330			170-17
18T	1004 031 000[1]	HSL 718	322 0340	293	40111801	170-18
19T	1004 032 000[1]	HSL 719	322 0350	294	40111901	170-19
20T	1004 033 000[1]	HSL 720	322 0360	295	40112001	170-20
21T	1004 034 000[1]		321 0370			
22T	1004 046 000[1]	HSL 722	333 4900			
Spacer	0518 018 000, J116	HMW 127		30	40112901	
Snap Ring	0512 011 000, DR 616E	HSL 721	321 2100	31	40112911	108

[1] Available flat under a different part number
[2] Also available flat as 321 0311
[3] Flat only
[4] Parts listed are all interchangeable although smaller dished sprockets may not fit with dish toward hub. Bendix, NK coaster brake and New Departure sprockets look similar but do not interchange with the above.

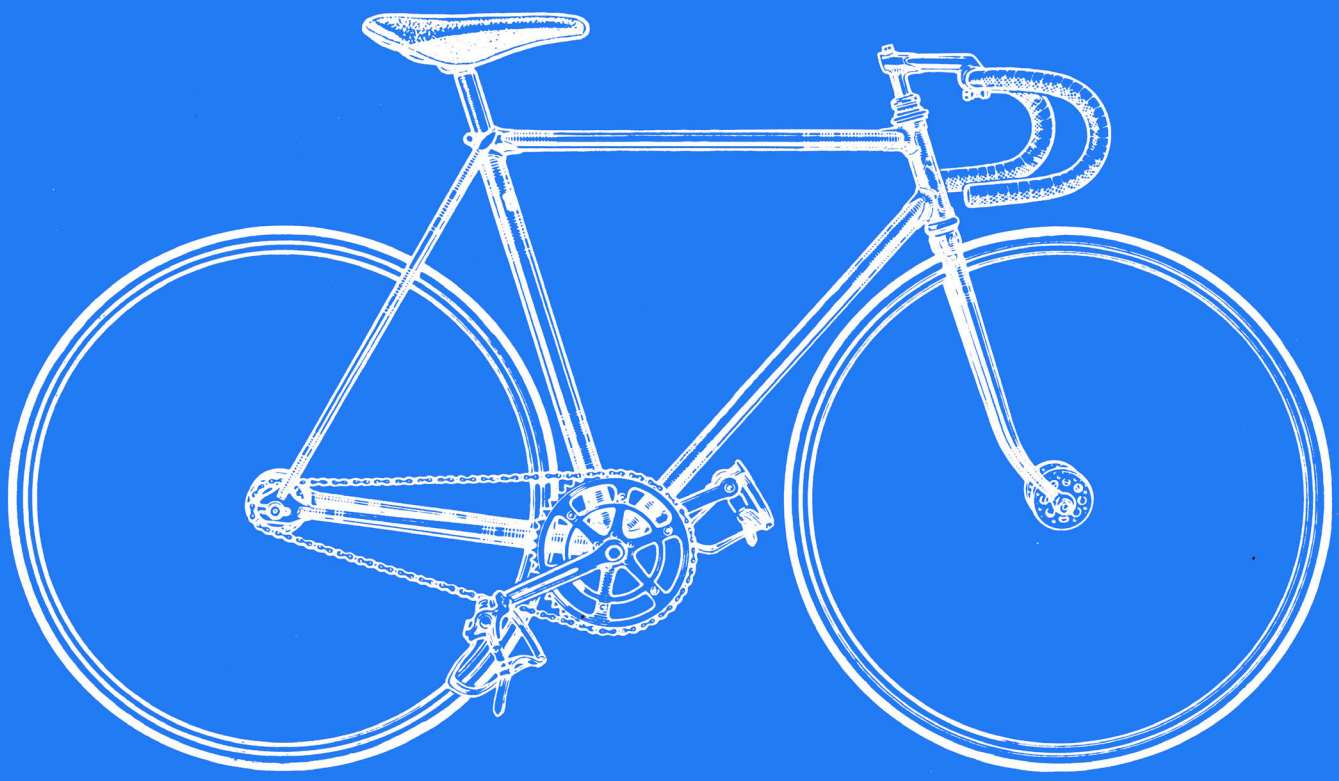
GEAR TABLE FOR INTERNALLY GEARED HUBS

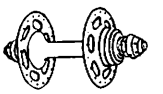
Multiply by gear value obtained from chainwheel and sprocket sizes.
(See formulas in Appendix)

GEAR / HUB	1	2	3	4	5
Bendix					
Red Band	0.68	1.00			
Yellow Band	0.68	1.00			
Blue Band	1.00	1.47			
F & S					
2-speed	0.73	1.00			
3-speed	0.73	1.00	1.36		
Shimano 3-speed	0.75	1.00	1.33		
Sturmey-Archer and imitations					
3-speed	0.75	1.00	1.33		
4-speed	0.67	0.79	1.00	1.27	
5-speed	0.67	0.79	1.00	1.27	1.50

— NOTES —

Coaster Brake





SINGLE SPEED COASTER BRAKES

Hub	Trouble Chart page	Parts Interchangeability Chart, Exploded Drawing page	Disassembly and Assembly Instructions page	Cleaning, Points to Check and Lubrication page	Axle Thread Size
Bendix	7-3	7-16	7-18	7-19	
Centrix (see F&S Sachs Jet)					3/8" x 26 TPI
F&S					
Komet Super	7-3	7-6	7-8	7-9	note[1]
Sachs Jet	7-3	7-6	7-8	7-9	
Torpedo	7-5	7-20	(see Sturmey-Archer SC)		
Torpedo Boy	7-3	7-6	7-8	7-9	
Hawthorne (see NK)					
Karat (see Centrix)					
Mattatuck (see NK)					
New Departure (see NK)					
NK	7-4	7-26	7-27	7-28	3/8" x 24 TPI
Perry	7-5	7-20	(see Sturmey-Archer SC)		3/8" x 26 TPI
Schwinn Approved (see F&S Komet Super)					3/8" x 24 TPI
Schwinn Approved Mark IV (see Sturmey-Archer SC)					3/8" x 26 TPI
Shimano					
Type A, B or D	7-3	7-10	7-12	7-14	3/8" x 24 TPI
Mighty Mite (similar to Type B)					3/8" x 24 TPI
Sturmey-Archer					
SC	7-5	7-20	7-22	7-23	3/8" x 26 TPI
SC1	7-3	7-20	7-24	7-25	3/8" x 26 TPI
Styre (see Sturmey-Archer SC)					
Sun Tour	7-3	7-15	(see Bendix)		3/8" x 24 TPI
Torpedo (see F&S Torpedo)					

BRAKE ARM MOUNTING

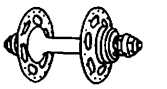
Coaster brakes have a brake arm which prevents the left-hand cone and axle from turning when the brake is applied. Attach the brake arm and axle nuts finger-tight before cinching down either. Make sure that the brake arm clamp will not pull the brake out of line as this will cause severe bearing alignment problems. Tighten axle nuts first, then brake arm clamp.

---

[1] Available with either *German Thread* 3/8" x 26 TPI or *American Thread* 3/8" x 24 TPI.

COASTER BRAKE TERMINOLOGY (by Manufacturer)
Numbers in parenthesis refer to parts chart and exploded drawing.

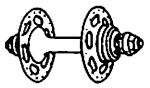
F & S	Shimano	Sun Tour	Bendix	Sturmey-Archer SC	Sturmey-Archer SC1	NK	Function
Driver, Inner Hub Barrel (12)	Driver (14)	Driver (12)	Drive Screw (15)	Driver (18)	Driver (18)	Driving Screw (13)	Transfers rotation from sprocket into hub mechanism.
Driving Cone (10)	Clutch Cone (12)	Clutch Cone (9)	Drive Clutch (12)	Driver Roller Assembly (19-20)	Brake Actuator (16)	Screw Cone (11)	Transfers rotation from driver to hub shell when pedalling forward.
			Drive-End Expander (8)	Actuator Roller Assembly (16)		Brake Clutch (9)	Squeezes braking surfaces together when back pedalling.
Brake Cylinder Assembly (9)	Clutch Spring (8)	Clutch Spring (7)	Retarder Spring (11)		Actuator Spring (15)	Clutch Band (10)	Senses driver direction (forward or backward) and engages appropriate clutch.
	Brake Shoe Assembly (10)			Brake Band (14)	Brake Band (14)		Rubs when braking.
		Brake Shoes (8)	Brake Shoes (9)				
						Brake Disc Set (8)	
Brake Cone, Lever Cone (7)	Brake Cone (7)	Brake Cone (6)	Anchor-End Expander (7)	Brake Cone (8)	Brake Cone (8)	Brake Disc Holder (6)	Keeps stationary braking surface from moving.
Brake Lever, Brake Arm (4)	Brake Arm (4)	Arm (3)	Brake Arm (4)	Brake Arm, Torque Arm (7)	Brake Arm, Torque Arm (7)	Brake Arm (4)	Holds brake cone or disc holder stationary.



INTERNAL EXPANDER TYPE COASTER BRAKES[2] TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
No brake (pedals slip backwards)	Keys or teeth on expanders, brake clutch or brake cylinder worn or damaged	
	Hub flanges loose on hub shell body	Retarder spring reversed or missing
	Stripped threads or splines or threads on sprocket	
Forward drive slips	Retarder spring worn or damaged	
	Drive screw or clutch threads worn or damaged	
Hub whines while coasting	Hub shell tapered surface worn or gouged	
Forward drive will not release	Axle bent	
	Bearing cones too tight	
Grinding, cracking noises	Chain too tight	
Hub binds and drags	Ball retainer damaged or broken	Ball retainer reversed
	Broken parts inside hub	
	Dustcap bent	
		Retarder spring reversed
Brake grabs	No lubrication	
Brake squeak	Brake arm loose at frame	
	Braking surfaces worn, glazed or burred	
	Improper lubrication—too slippery	
Poor braking	Tapered surfaces of expanders or brake shoes burred	
	Brake parts worn	
Too much reverse pedal travel	Adjusting cone too loose	

[1] Bendix, F & S, Shimano, Sun Tour, Sturmey-Archer SC1.
[2] See Coaster Brake Terminology chart for parts numbers.

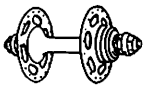


HUBS

NK MATTATUCK and NEW DEPARTURE MULTIPLE DISC COASTER BRAKE TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
	Brake disc (8) tabs worn off	
	Screw cone (11) or brake clutch (9) teeth worn or damaged	
No brake (pedals slip backwards)	Hub flanges loose on hub shell body	
	Sprocket splines stripped	
	Clutch band (10) weak or bent	
Forward drive slips	Driver (13) or screw cone (11) threads worn or damaged	
Hub whines while coasting	Hub shell or screw cone (11) tapered surface worn or gouged	
Forward drive will not release	Axle bent	
	Adjusting cone (19) too tight	
Grinding, cracking noises	Chain too tight	
Binds and drags	Ball retainer damaged or broken	Ball retainer reversed
	Broken parts inside hub	
	Dustcap bent	
	No lubrication	
Brake grabs	Brake arm (4) loose at frame	
Brake squeaks	Brake discs (8) worn, glazed, polished or burred	
	Improper lubrication—too slippery	Brake discs (8) improperly stacked
Poor braking	Brake clutch (9) or screw cone (11) teeth worn	
	Brake parts worn	
Too much reverse pedal travel	Clutch band (10) weak	Too few disks (8)
	Adjusting cone (19) too loose	

[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.



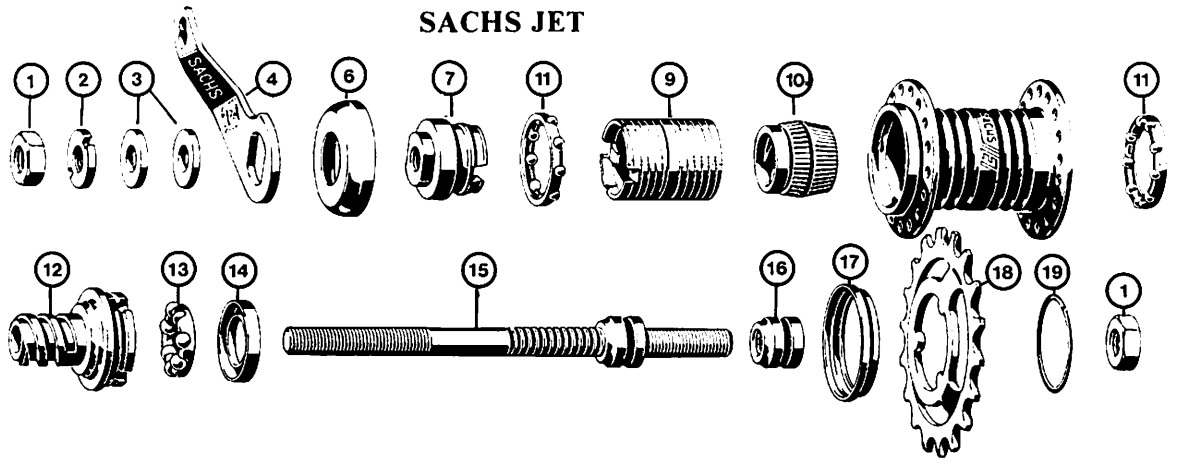
STURMEY-ARCHER SC ROLLER DRIVE COASTER BRAKE TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
	Adjusting cone too loose	
	Brake parts worn	
Too much reverse pedal travel	Actuator (16) roller retainer bent, broken	
No brakes (pedals slip backwards)	Actuator (16) race or rollers worn or damaged	Actuator (16) rollers improperly installed
	Hub flanges loose on hub shell	
Forward drive slips Forward drive will not release	Driver rollers (20) or cage dirty or damaged	Driver rollers (20) improperly installed
	Axle (25) bent	
	Brake cone (8) too tight	
Grinding, cracking noises	Chain too tight	
	Ball retainer damaged or broken	Ball retainer reversed
Hub binds and drags	Broken parts inside hub	
	Dustcap bent	
	Hub shell roller race worn or damaged	
Brake grabs	No lubrication	
	Brake arm (7) loose at frame	
Brake squeaks	Braking surfaces glazed, polished or burred	
Poor braking	Improper lubrication—too slippery	
	Brake parts worn	
	Brake cone (8) too loose	

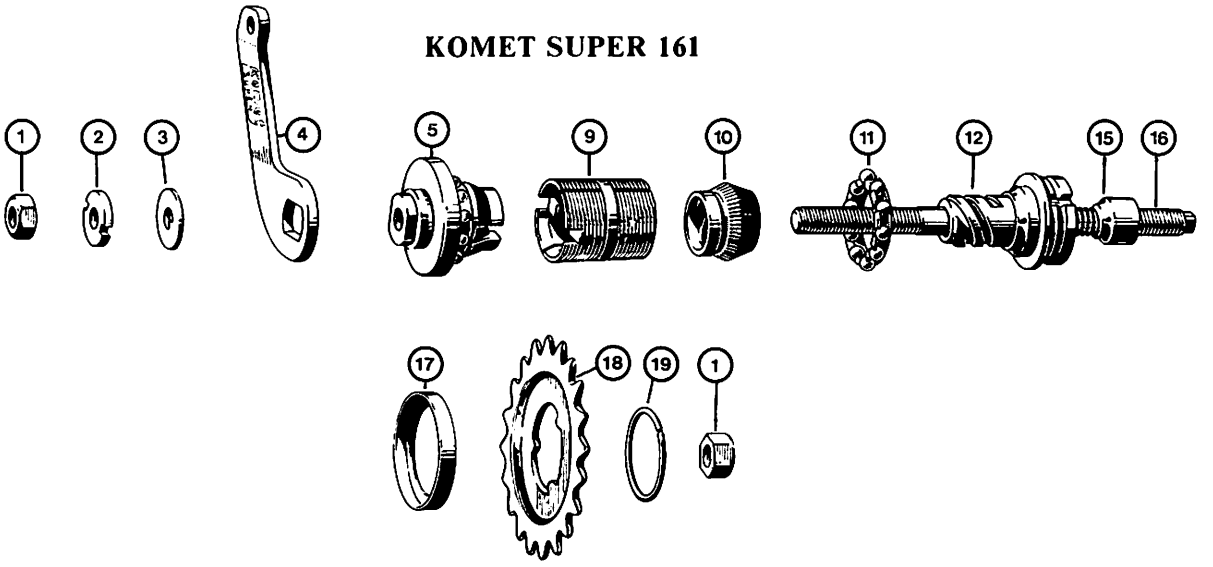
[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.

HUBS

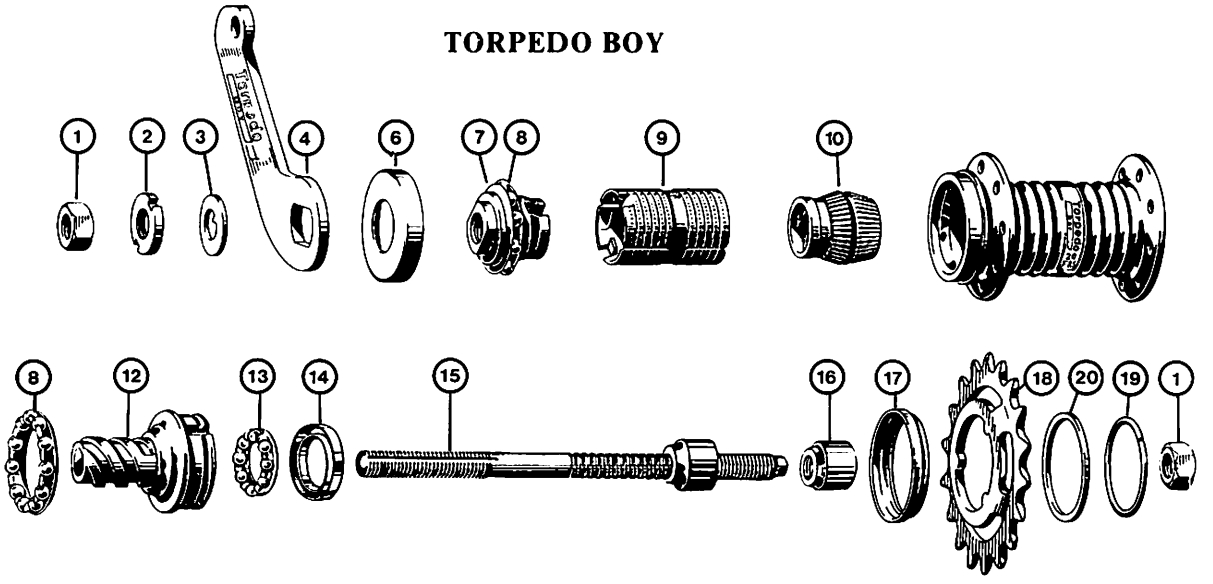
F&S COASTER BRAKES
SACHS JET

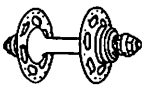


KOMET SUPER 161



TORPEDO BOY





F & S COASTER BRAKES
PARTS INTERCHANGEABILITY

| Vertical line between numbers indicates parts are not interchangeable.

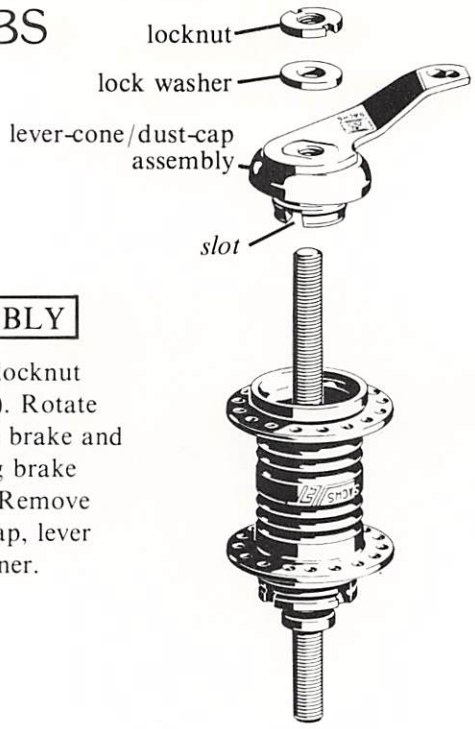
Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

		Sachs Jet	Komet Super 161[1]	Komet Super	Torpedo Boy (Pixie F & S Boy)	Torpedo Boy (New Part Numbers)
1.	Axle Nuts (2)					
	3/8 x 26 TPI[2]	0316 061 004	T 93	T 93	T 93	0316 061 004
	3/8 x 24 TPI[2]	1603 026 000	T 93A	T 93A	T 93A	1603 026 000A
2.	Lock Nuts					
	3/8 x 26 TPI[2]	1603 017 100	K 102	K 102	K 102	1603 017 000
	3/8 x 24 TPI[2]	1603 019 000	K 102A	K 102A	K 102A	1603 019 000A
3.	Washer	2318 003 000	T 77	T 77	T 77	
4.	Brake Arm	2319 004 100	K 108	K 108	J 108	2319 001 100
5.	Brake Cone / Dust Cap / Ball Retainer Assembly					
	3/8 x 26 TPI[2]					2307 001 100
	3/8 x 24 TPI[2]		K 161/2A			2374 004 001A
6.	Dust Cap	2321 006 000	K 161/1	K 104	J 104	2321 001 000
7.	Brake Cone					
	3/8 x 26 TPI[2]	2374 006 100[4]		K 101	J 101	
	3/8 x 24 TPI[2]	2307 003 101		K 101A		
8.	Ball Retainer		Star S 2051	K 106 (Star K 91)	J 106 (Star 130)	2376 001 200
9.	Brake Cylinder	2373 002 000[5]	K 113	K 113	J 113	2373 001 000
	Spring for Brake Cylinder		K 113A	K 113A		
10.	Driving Cone	2306 002 100[5]	K 107	K 107	J 107	2306 001 000
11.	Ball Retainer	2376 002 001[5] Star 0103-247	K 161/4 S 2050	K 105 Star K 042	J 106 Star 130	
12.	Driver Assembly (Inner Hub Barrel)	2372 004 100[5]	K 161/5	K 114	J 114	2372 001 401
13.	Ball Retainer	2376 003 000 Star 0103-519	K 161/5A Star S 1025	10-1/4" loose balls	10-1/4" loose balls or S-1025	1676 103 100
14.	Dust Cap	1604 013 002	K 112A			1604 013 002
15.	Axle with Fixed Cone					
	3/8 x 26 TPI[2]		K 110/4	K 110/4	J 110/4	2371 008 000
	3/8 x 24 TPI[2]	1671 103 000[5]	K 110/4A	K 110/4A	J 110/4A	1671 103 001A
16.	Fixed Cone					
	3/8 x 26 TPI[2]		K 110	K 110	J 110	
	3/8 x 24 TPI[2]	2308 003 101	K 110A	K 110A	J 110A	1608 101 000A
	Oiler	none			T 82K	
17.	Dust Cap, sprocket side	2321 002 101	K 161/6	K 103	J 103	2321 002 101
18.	Sprockets, 17-22[3]					
19.	Sprocket Lockrings[3]	0512 011 000	DR-616E	DR-616E	DR-616E	0512 011 000
20.	Sprocket Spacer Washer[3]	none required	none required	none required	J 116 2 required except with 12T sprocket	0518 018 000

[1] 161 is stamped on hub shell.
[2] 3/8 x 26 TPI is sometimes referred to as German thread. 3/8 x 24 TPI is sometimes referred to as American thread. American threaded parts have A stamped in them.
[3] See Sprocket Interchangability at beginning of Hub section.
[4] Includes brake arm and cone.
[5] There are several similar part numbers for these items.

HUBS

F & S COASTER BRAKE DISASSEMBLY AND ASSEMBLY[1]



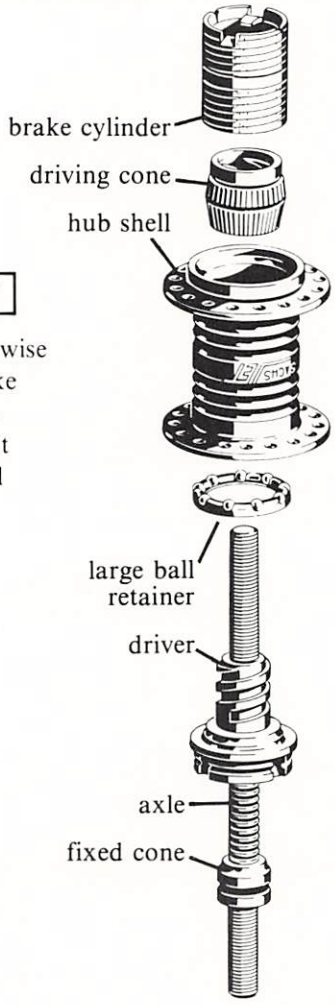
(1) DISASSEMBLY

Remove left-hand locknut and washer (if any). Rotate driver to disengage brake and unscrew cone using brake lever as a wrench. Remove brake lever, dust cap, lever cone and ball retainer.

Next Step

Thread lever-cone/dust-cap assembly onto axle. Cone slots must engage brake cylinder tabs and ball retainer must seat in hub race. Replace lock washer (if any) and lock nut. Adjust bearing.

ASSEMBLY (2)



Next Step

(2) DISASSEMBLY

Rotate hub counter-clockwise and lift off axle. Lift brake cylinder and driving cone out of hub either as a unit or separately. Lift off ball retainer and driver.

Install driver. Small ball retainer in driver seats onto fixed axle cone. Slip large ball retainer over driver *flat side down.* Slip hub shell over axle *smaller opening down.* Push small end of driving cone into straight-sided end of brake cylinder. Install driving cone and brake cylinder as a unit.[2] Rotate clockwise to engage driver splines.

ASSEMBLY (1)

[1] These hubs may also be disassembled by threading out the axle first and replacing it last. This procedure is especially recommended for Karat and Centrix hubs.

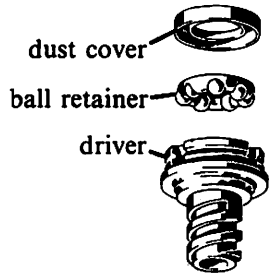
[2] For Karat and Centrix assemble brake shoes, lever cone and driving cone and install as a unit.

F & S COASTER BRAKE
DISASSEMBLY AND ASSEMBLY (cont.)
SUBASSEMBLIES

DISASSEMBLY

Driver

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.



Driver

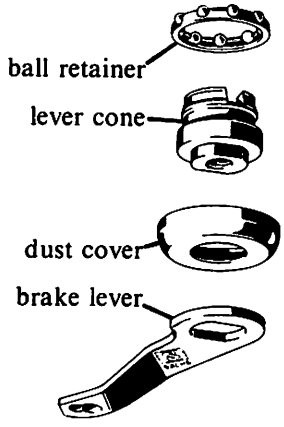
Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

ASSEMBLY

DISASSEMBLY

Lever-Cone/Dust-Cap

If brake lever, lever cone and dust cover are press fit together, they should not be forced apart. Ball retainer may be popped off cone.



Lever-Cone/Dust-Cap

Reassemble lever cone, dust cover and brake lever if they have been separated. Pop ball retainer over cone, *flat side toward dust cover.*

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

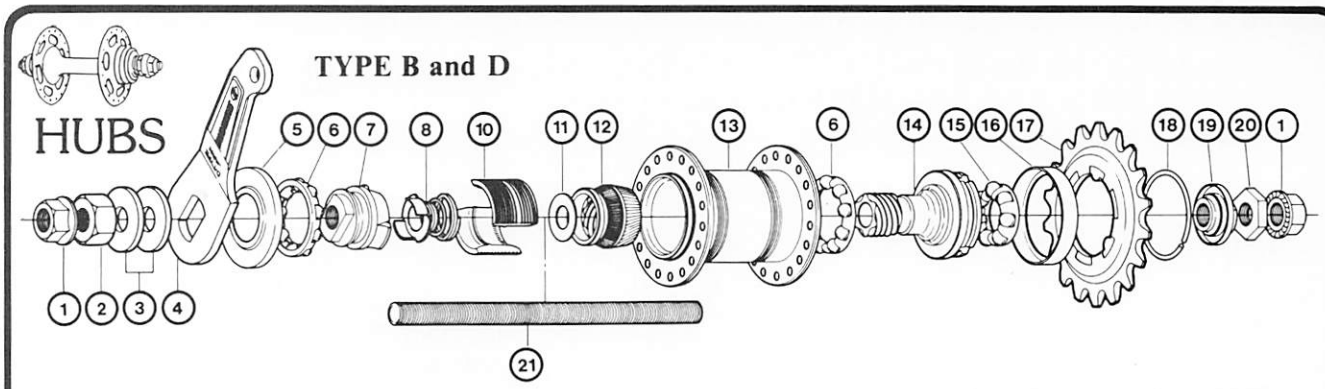
Numbers in parenthesis refer to parts chart and exploded drawing.

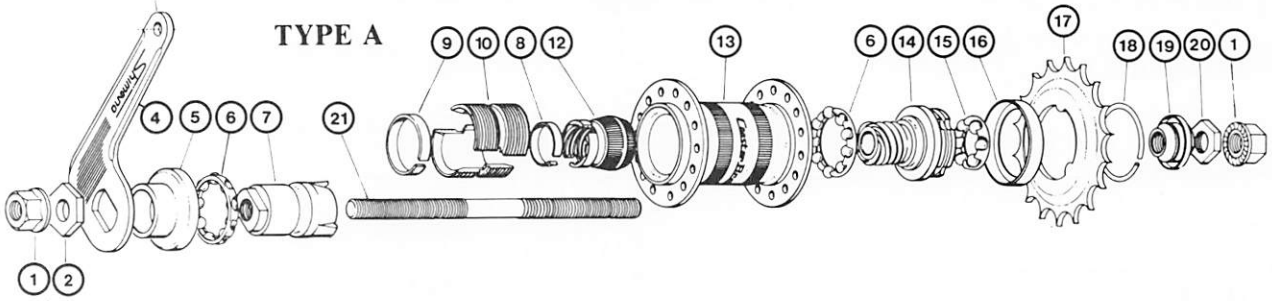
1. Mating threads of driving cone (10) and driver (12) for wear and chipping
2. Conical surface of inside of hub shell and outside of driving cone (10) for wear and burring
3. Brake shoes and driving cone (10) for wear and burring
4. Brake cylinder (9) and hub shell mating surfaces for wear or glazing
5. All threaded parts for damaged or stripped threads
6. Dustcaps and bearing retainers for straightness

LUBRICATION

Lubricate ball retainer by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Grease other internal parts.

HUBS

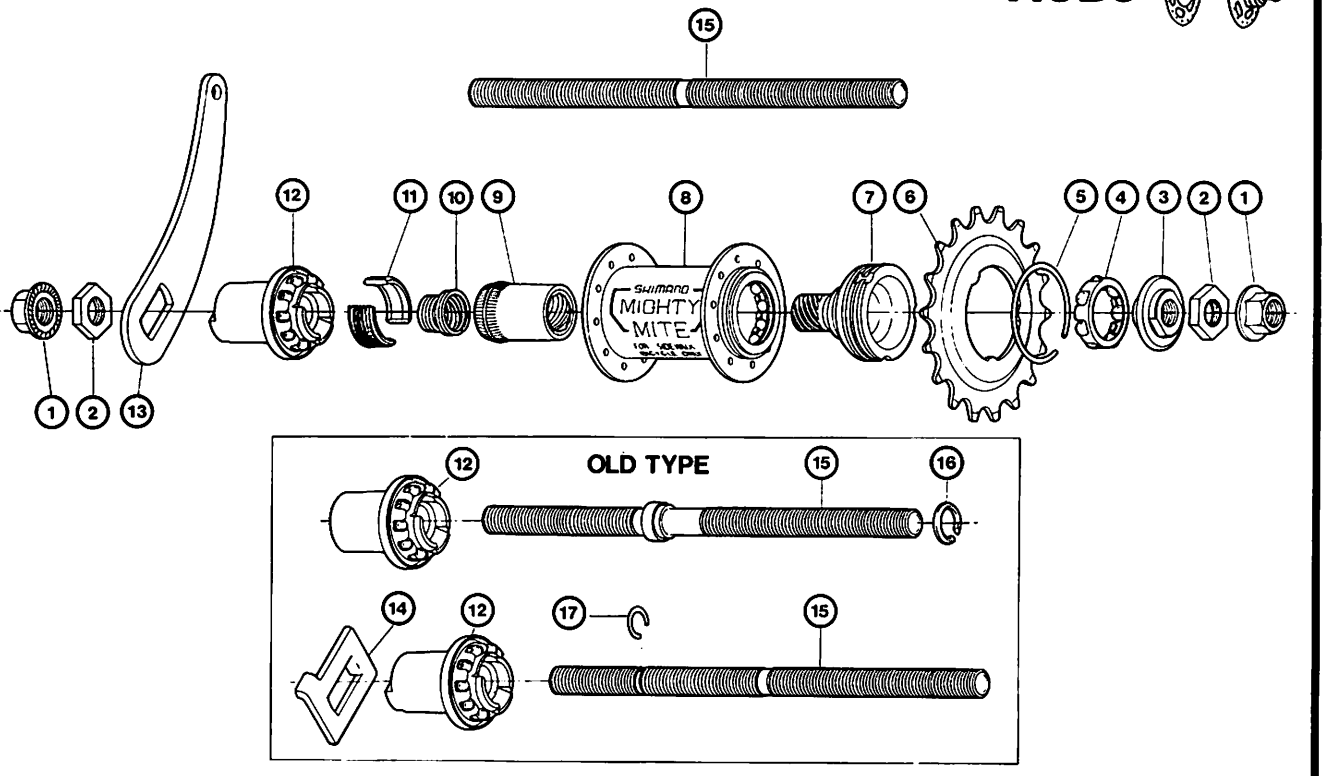




SHIMANO COASTER BRAKE PARTS INTERCHANGABILITY

		D Type	B Type	A Type Model 42[1]	A Type Model 45[1]
1.	Flange Nut	282 3000	282 3000	282 3000	282 3000
2.	Arm Nut	283 0900-1	283 0900	282 2400	282 2400
3.	Arm Washer	283 1600-1	283 1600		
4.	Brake Arm	283 1400-1	283 1400	282 2100	282 2100
5.	Left-Hand Dust Cap	283 1300-1	283 1300	282 1900	282 1900
6.	Ball Retainer C	282 9005	282 9005	282 9005	282 9005
7.	Brake Cone	283 1100	283 1100	282 1600	282 1600
8.	Clutch Spring	283 9033	283 0600	282 2500	282 2500
9.	Shoe Spring			282 2300	282 2300
10.	Brake Shoe	283 1000	283 1000	282 1500	282 1500
11.	Clutch Washer	283 1500	283 1500		
12.	Clutch Cone	283 1200	283 1200	282 1400-1	282 1400-1
13.	Hub Shell 24 holes @ 2.5 mm	283 9012	283 9012		
	28 holes @ 2.8 mm	283 9003	283 9003	282 9001	282 9001
	28 holes @ 3.2 mm	283 9004	283 9004		
	36 holes @ 2.8 mm	283 9005	283 9005	282 9003	282 9003
	20 holes			282 9002	282 9002
14.	Driver	283 0700	283 0700	282 1300-1[1]	282 1301-1[1]
15.	Ball Retainer A	321 9022	321 9022	321 9022	321 9022
16.	Right-Hand Dust Cap	282 2000	282 2000	282 0510[1]	282 3100[1]
17.	Sprocket[2] 14T	321 0300	321 0300	321 0300	321 0300
	15T	321 0311	321 0311	321 0310	321 0310
		flat	flat	dished	dished
	16T	321 0320	321 0320	321 0320	321 0320
	17T	321 0330	321 0330	321 0330	321 0330
	18T	322 0340	322 0340	321 0340	321 0340
	19T	322 0350	322 0350	321 0350	321 0350
	20T	322 0360	322 0360	321 0360	321 0360
18.	Snap Ring[2]	321 2000	321 2000	321 2000	321 2000
19.	Cone with Dust Cap	281 9013	281 9013	281 9013	281 9013
20.	Locknut	281 2100	281 2100	281 2100	281 2100
21.	Hub Axle 150 mm (5.90″)			282 1203	282 1203
	158 mm (6 7/32″)	283 0504	283 0504		
	163 mm (6 13/32″)	283 0501	283 0501	282 1200	282 1200
	170 mm (6 11/16″)	283 0503	283 0503	282 1202	282 1202

[1] Model 45 was used by Ross (Chain Bike Corporation).
45 indicates the chainline in millimeters from hub center to sprocket center.
[2] See Sprocket Interchangeability at beginning of Hub section.



SHIMANO MIGHTY MITE COASTER BRAKE PARTS INTERCHANGEABILITY

| Vertical line between numbers indicates parts are not interchangeable.

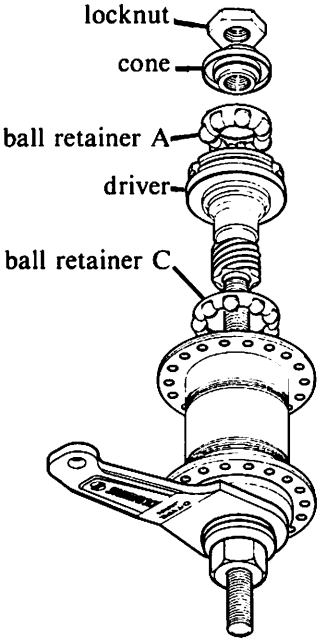
Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

Item #		New Type	Old Type with brake plate	Old Type with serrated brake plate
1.	Flange Nut	282 3000[1]	282 3000[1]	282 3000[1]
2.	Locknut	281 2100[1]	281 2100[1]	281 2100[1]
3.	Cone with Dust Cap	284 9005	284 9005	284 9005
4.	Ball Retainer	321 9022[1]	321 9022[1]	321 9022[1]
5.	Snap Ring[2]			
6.	Sprockets[2]			
7.	Driver	284 1500	284 1500	284 1500
8.	Hub Shell 24 holes	284 9003	284 9003	284 9003
9.	Clutch Cone	284 1300	284 1300	284 1300
10.	Clutch Spring	284 1101	284 1100	284 1100
11.	Brake Shoe	284 1200	284 1200	284 1200
12.	Brake Cone with Ball Retainer	284 9020	284 9002	284 9004
13.	Brake Arm	284 2100		
14.	Brake Plate		284 0601	
15.	Hub Axle 155 mm	284 0511		
	163 mm	284 0512	284 0501	284 0506
	187 mm	284 0513	284 0502	284 0507
16.	Lock Ring			284 1600
17.	Snap Ring B		284 0700	

[1] Interchangeable with Shimano B and D type.
[2] See Sprocket Interchangeability at beginning of Hub section.

HUBS

SHIMANO TYPE A, B AND D COASTER BRAKES DISASSEMBLY AND ASSEMBLY



(1) DISASSEMBLY

Note the distance that axle protrudes at each end of hub. Remove locknut, cone, small ball retainer (A), driver and large ball retainer (C).[1]

Next Step ⬇

ASSEMBLY (3)

Replace large ball retainer (C)[1] *flat side up*. Install driver and small ball retainer (A) *flat side up*. Install cone and locknut and adjust bearing.

---

(2) DISASSEMBLY

Next Step ⬆

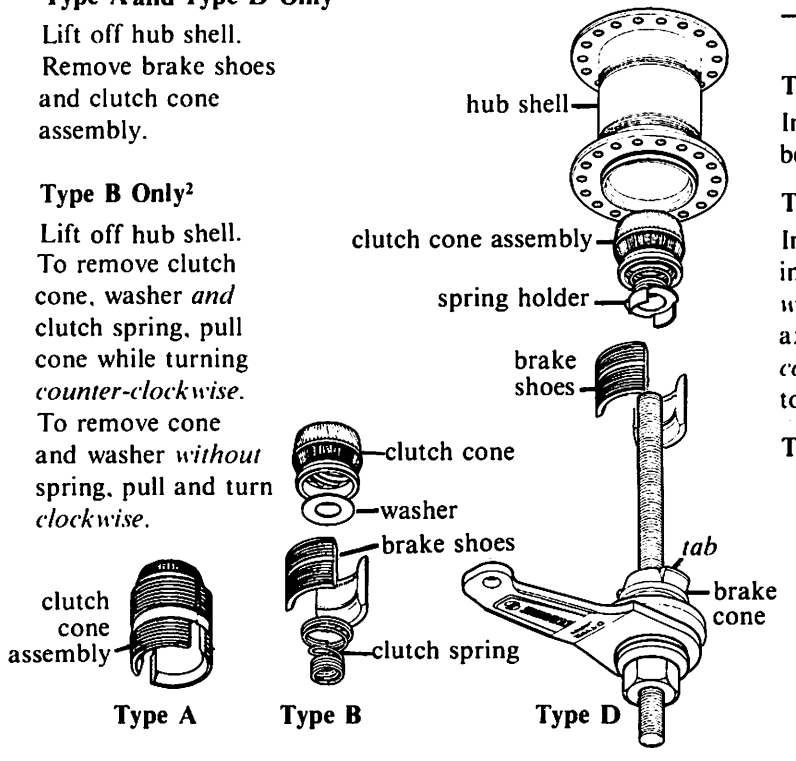
Position hub shell *straight-sided opening down* and slip over assembly.

Type A and Type D Only

Lift off hub shell. Remove brake shoes and clutch cone assembly.

Type B Only[2]

Lift off hub shell. To remove clutch cone, washer *and* clutch spring, pull cone while turning *counter-clockwise*. To remove cone and washer *without* spring, pull and turn *clockwise*.



Next Step
Next Page ⬇

⬆

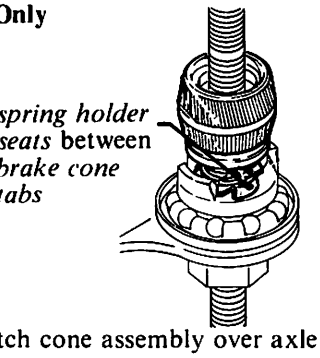
Type A Only

Install clutch cone assembly seating gaps between brake shoes over brake cone tabs.

Type B Only

Insert clutch washer and large end of spring in smooth end of clutch cone with a *clockwise* turning motion. Advance spring along axle, push clutch cone and turn assembly *counter-clockwise*. Continue until spring touches brake cone.

Type D Only



Slip clutch cone assembly over axle seating spring holder *between* brake cone tabs as shown above.

ASSEMBLY (2)

---

[1] On Mighty Mite coaster brake large ball retainer is installed under a press-fit dust cover (not shown). Remove carefully with a thin-bladed screwdriver. To install, start straight by hand and tap home with a soft hammer.

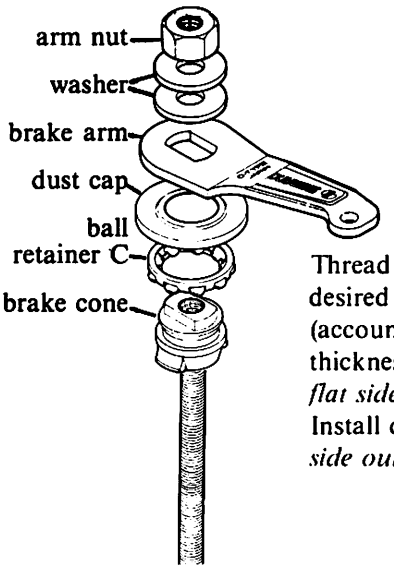
[2] Mighty Mite is similar to Type B.

SHIMANO TYPE A, B AND D COASTER BRAKES DISASSEMBLY AND ASSEMBLY (cont.)

Next Step
Preceding Page

3 DISASSEMBLY

To remove ball retainer C, remove arm nut, arm washer and brake arm. Push off dust cap and ease ball retainer over small end of brake cone. If required, brake cone may be threaded off axle.[1]



Thread brake cone onto axle until desired length of axle protrudes[1] (account for arm nut and washer thickness). Ease large ball retainer (C) *flat side up* over small end of cone. Install dust cap, brake arm *(imprinted side out)*, washers and arm nut.

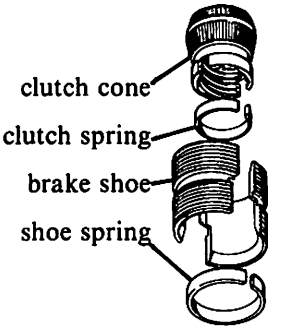
ASSEMBLY 1

SUBASSEMBLIES

DISASSEMBLY

Type A Only
Clutch Cone

Pull brake shoe assembly off clutch cone. Remove shoe spring or clutch spring only if it is to be replaced.



Type A Only
Clutch Cone

Assemble brake shoes and shoe spring. Rotate gap in spring away from gap between shoes. Ease clutch spring over small end of clutch cone with hooked end of spring *clockwise from spring gap.* Incorrect installation will cause excessive drag and wear.

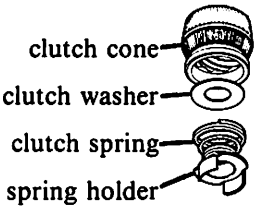
Insert small end of clutch cone into narrow-slot end of brake shoe assembly. Hooked end of clutch spring engages one of the narrow slots between brake shoes.

ASSEMBLY

DISASSEMBLY

Type D Only
Clutch Cone

Pull *spring holder* free with a *counter-clockwise* turning motion. Pull *clutch cone* free with a *clockwise* turning motion. Remove clutch washer.



Type D Only
Clutch Cone

Insert washer and large end of clutch spring into smooth end of clutch cone with a *clockwise* turning motion. Push spring holder into small end of clutch spring with a *counter-clockwise* turning motion.

ASSEMBLY

---

[1] On Mighty Mite, cone is tightened against a snap ring around the axle. To remove, loosen by threading cone inward ½ turn, remove snap ring and thread cone off axle. To install, thread cone past snap ring groove, install snap ring and turn cone back until tightened against ring.

SHIMANO TYPE A, B AND D COASTER BRAKES DISASSEMBLY AND ASSEMBLY (cont.)

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

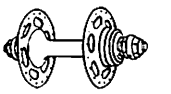
POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

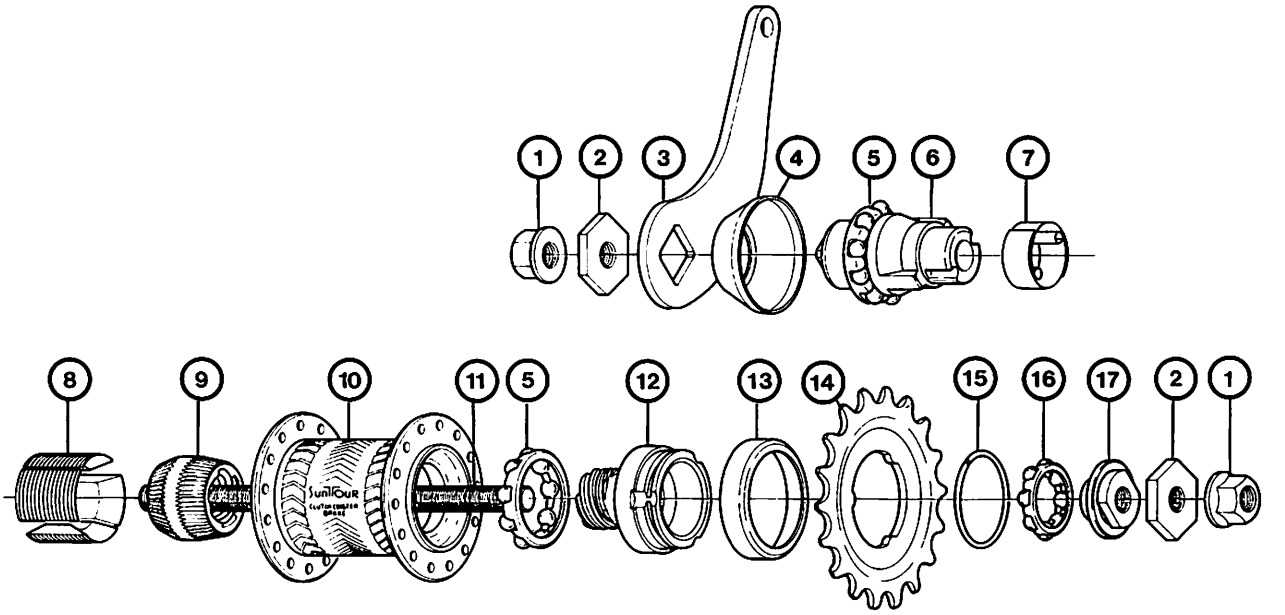
1. Mating threads of clutch cone (12) and driver (14) for wear and chipping
2. Conical surface of inside of hub shell and outside of clutch cone (12) for wear and burring
3. Clutch spring (8) for shape and tension
4. Brake shoe (10) and hub shell mating surfaces for wear or glazing
5. All threaded parts for damaged or stripped threads
6. Dustcaps and bearing retainers for straightness
7. All bearing races and balls for wear or pitting

LUBRICATION

Lubricate ball retainers by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Grease other internal parts.



SUNTOUR COASTER BRAKE



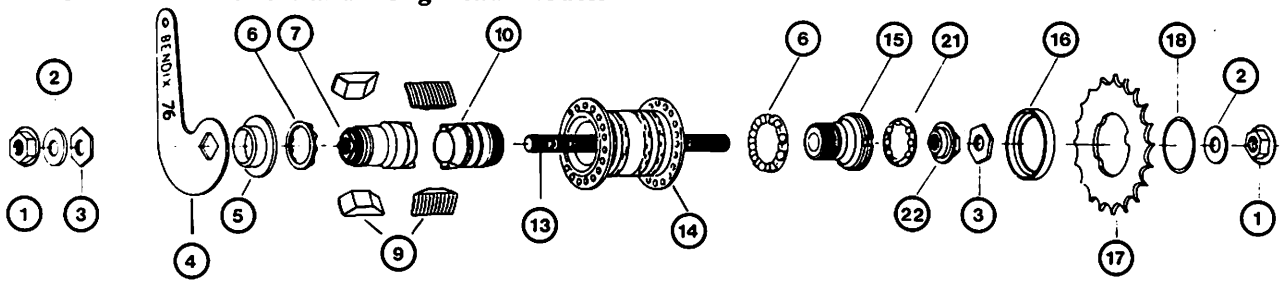
1.	Axle nut	42005800
2.	Lock nut, 4 mm	42005700
	Lock nut, 5 mm	42005701
3.	Arm	42001000
4.	Dust cap (B)	42001500
5.	Ball retainer (B)	42008800
6.	Brake cone	42000700
7.	Clutch spring	42007002
8.	Brake shoe	42000800
9.	Clutch cone	42000600
10.	Hub shell, 20 H	42009010
	Hub shell, 28 H	42009012
	Hub shell, 36 H	42009014
11.	Axle, 152 mm	42000301
	Axle, 162 mm	42000304
	Axle, 170 mm	42000306
12.	Driver	42000400
13.	Dust cap (A)	42001600
14.	Sprocket[1]	
15.	Lock ring[1]	
16.	Ball retainer (A)	40119023
17.	Cone screw	42009000

[1] See Sprocket Interchangability at beginning of Hub section.

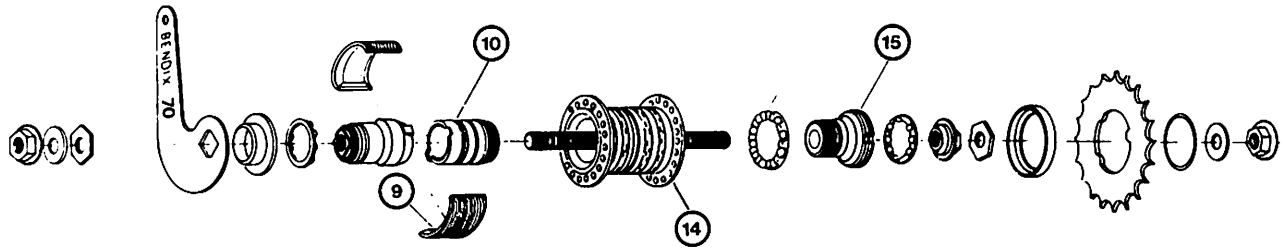
HUBS

BENDIX COASTER BRAKE

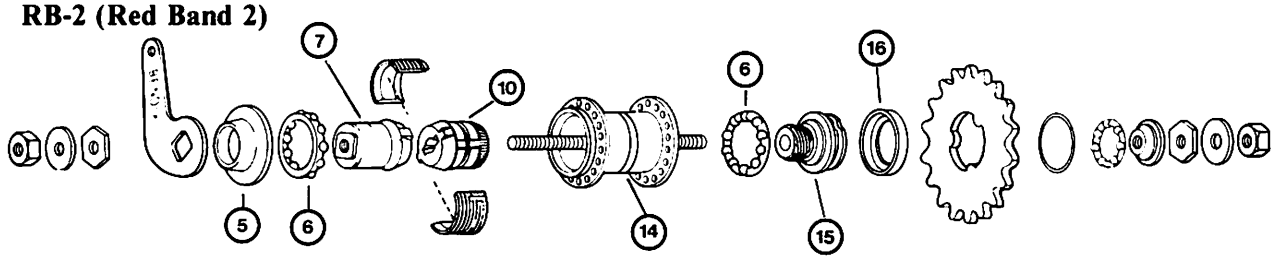
MODEL 76 — Short and Long Lead Models



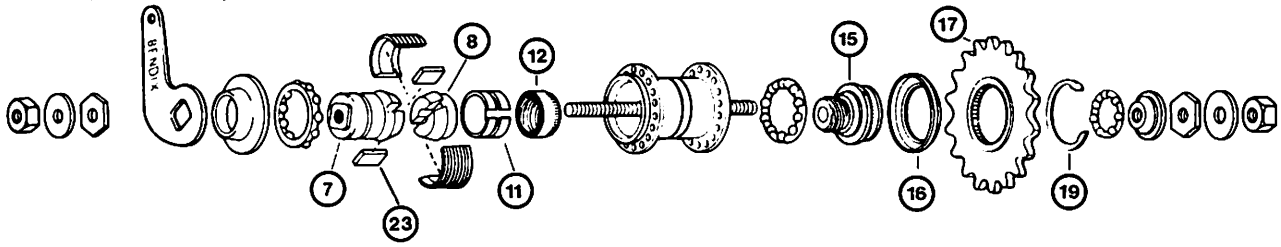
MODEL 70



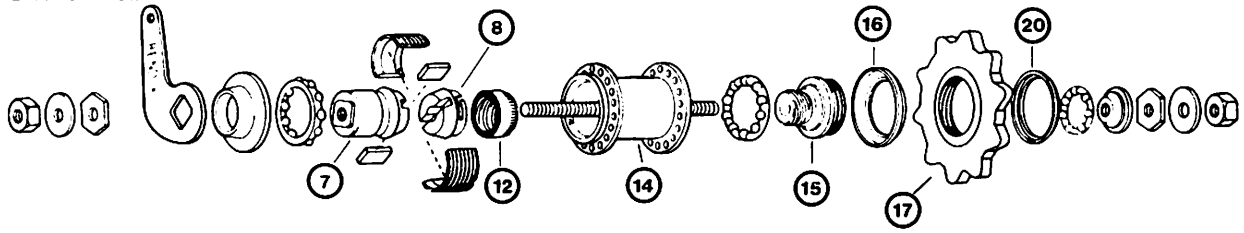
RB-2 (Red Band 2)



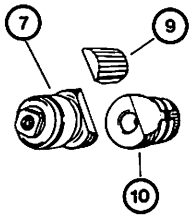
RB (Red Band)

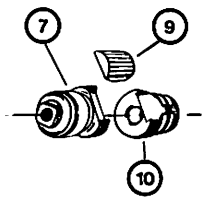


ORIGINAL

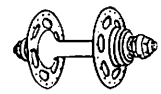


MODEL 70J (70 Junior)
other parts interchangable with Model 70





JUNIOR
other parts interchangable with RB-2



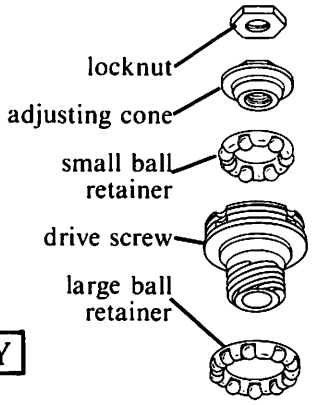
BENDIX COASTER BRAKE PARTS INTERCHANGEABILITY

Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

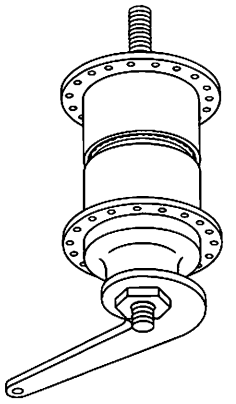
		76 short lead models and long lead models	70, 70J 70 Junior	RB-2 Red Band -2, Junior	RB Red Band	Original Bendix
1.	Axle Nut (2 required)	BB-713	BB-13A	BB-13A	BB-13A	BB-13
2.	Axle Washer	BB-14A	BB-14A	BB-14A	BB-14A	BB-14
3.	Locknut	BB-15	BB-15	BB-15	BB-15	BB-15
4.	Brake Arm	BB-710	BB-510	BB-10	BB-10	BB-10
	Junior		BB-610			
	Tandem	BB-710A	BB-510A	BB-10A	BB-10A	BB-10A
5.	Dust Cap, arm side	BB-532	BB-532	BB-32	BB-32	BB-32
6.	Retainer (9-¼" balls) (2 required)					
	(BB-16 10-¼" balls)	BB-516	BB-516	BB-16	BB-16	BB-16
7.	Expander, anchor end	BB-533	BB-533	BB-133	BB-59	BB-33
	Junior Expander, anchor end		BB-633	BB-233		
8.	Expander, drive end				BB-56	BB-6
9.	Brake Shoes (BB-722, 4 required)					
	(BB-22, 2 required)	BB-722	BB-22	BB-22	BB-22	BB-22
	Junior Brake Shoes (1 required)		BB-222	BB-222		
10.	Retarder Sub-Assembly, short lead (0.667")	BB-159	BB-159	BB-159		
	long lead, zinc plated (0.900")	BB-759				
	Junior Retarder Sub-Assembly		BB-659	BB-259		
11.	Retarder Spring	BB-112	BB-112	BB-112	BB-112	
12.	Drive Clutch				BB-53	BB-3
13.	Axle 6⅜" (162 mm) standard length	BB-4	BB-4	BB-4	BB-4	BB-4
	7⅜" (187 mm) extra length	BB-36	BB-36	BB-36	BB-36	BB-36
	6⅜" (162 mm) high strength, yellow	BB-4A				
14.	Hub Shell 36 holes 0.080 gauge	BB-781	BB-581	BB-81	BB-81	BB-1
	28 holes 0.080 gauge	BB-782	BB-582	BB-82	BB-82	BB-1B
	24 holes 0.080 gauge	BB-783	BB-583	BB-83	BB-83	BB-1A
	20 holes 0.080 gauge	BB-786	BB-586	BB-86	BB-86	
	40 holes 0.080 gauge			BB-87		
	28 holes 0.105 gauge	BB-787				
	36 holes 0.105 gauge	BB-784	BB-584	BB-84	BB-84	BB-1E
	36 holes 0.120 gauge	BB-785	BB-585	BB-85	BB-85	BB-1C
15.	Drive Screw 6-start multiple thread	BB-502	BB-502	BB-102		
	long lead, zinc plated	BB-702				
	3-start multiple thread				BB-52	BB-2
16.	Dust Cap, sprocket	BB-558	BB-558	BB-158	BB-58	BB-31
17.	Sprocket 14T	BB-143	BB-143	BB-143		BB-43
	15T	BB-142	BB-142	BB-142		
	16T	BB-144	BB-144	BB-144		BB-44
	18T	BB-145	BB-145	BB-145	BB-60	BB-45
	19T	BB-146	BB-146	BB-146	BB-61	BB-46
	20T	BB-147	BB-147	BB-147	BB-62	BB-47
	22T	BB-148	BB-148	BB-148	BB-64	
18.	Snap Ring	BB-155	BB-155	BB-155		
19.	Sprocket Retaining Ring				BB-55	
20.	Sprocket Locknut (left-threaded)					BB-5
21.	Retainer (7-¼" balls No. 19)	BB-20	BB-20	BB-20	BB-20	BB-20
22.	Adjusting Cone	BB-7	BB-7	BB-7	BB-7	BB-7
23.	Brake Shoe Key				BB-51	BB-51

BENDIX COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)



(1) DISASSEMBLY

Remove right-hand locknut, adjusting cone, small ball retainer, drive screw and large ball retainer.

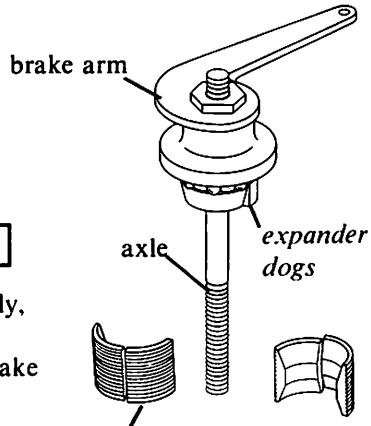


Holding axle in place, turn hub over. Install large ball retainer *flat side up.* Install drive screw and small ball retainer. Thread on adjusting cone and locknut. Adjust bearing.

ASSEMBLY 3

Next Step

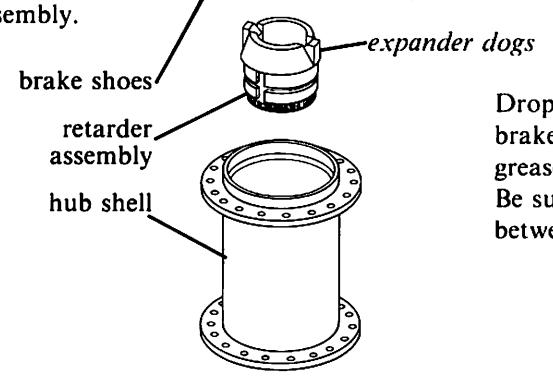
Next Step



(2) DISASSEMBLY

Without inverting assembly, lift hub shell clear of remaining parts. Catch brake shoes as they fall out. Remove retarder assembly.

Insert brake-arm/axle assembly into hub with dogs on anchor-end expander seated in gaps between brake shoes and ball retainer seated on hub shell race.



Drop retarder sub-assembly into the brake shell *expander end up.* Stick greased brake shoes in place inside hub. Be sure that expander dogs lie in gaps between brake shoes.

ASSEMBLY 2

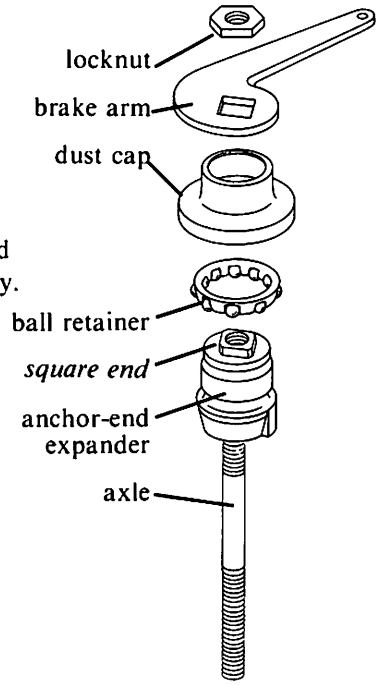
Next Step
Next Page

BENDIX COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

Next Step
Preceding Page

3 DISASSEMBLY

Remove left-hand locknut, brake arm and dust cap. Pop ball retainer off over anchor-end expander. Thread expander off axle if necessary.



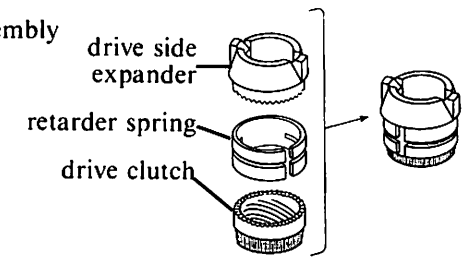
Install anchor-end expander. Square end should be 1⅛" (28mm) from end of axle. *Place large ball retainer over the expander flat side up.* Use dust cap to pop ball retainer into place. Install brake arm and locknut. Tighten locknut by holding it stationary while turning brake arm against it.

ASSEMBLY 1

DISASSEMBLY

Retarder
Pull retarder sub-assembly apart.

SUBASSEMBLY



Retarder
Install the retarder spring on the drive side expander. Install the drive clutch in the retarder spring.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

1. Mating threads of drive screw (15) and drive clutch[1] (12) for wear and chipping
2. Conical surface of inside of hub shell and outside of drive clutch[1] (12) for wear and burring
3. Retarder spring (11) for shape and tension
4. Drive clutch[1] (12) and drive side expander (10) for wear or burring of toothed mating surfaces
5. Brake shoes (9) and hub shell mating surfaces for wear or glazing
6. All threaded parts for damaged or stripped threads
7. Dustcaps and bearing retainers for straightness

LUBRICATION

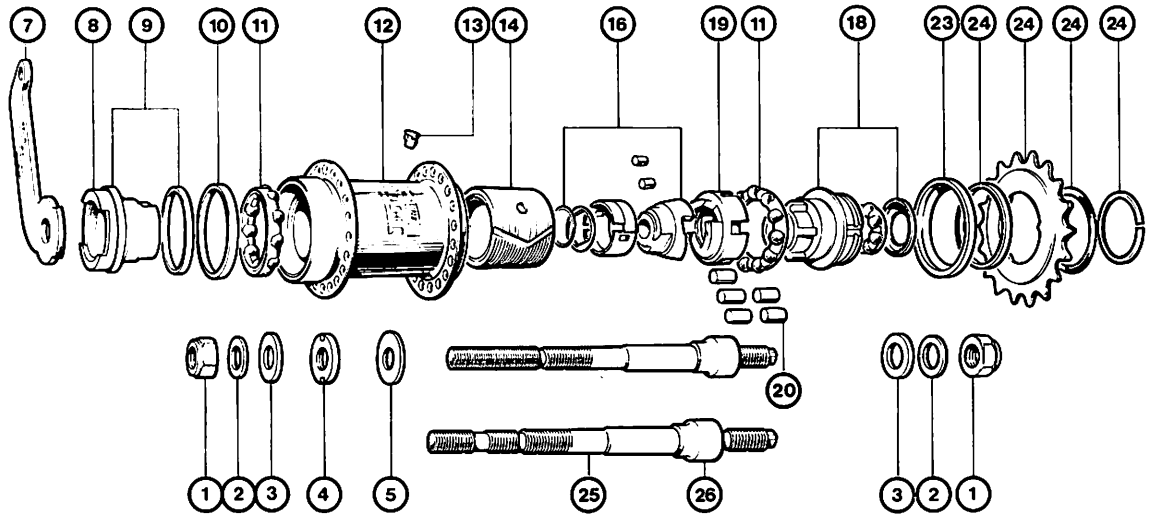
Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Coat other parts with grease.

[1] For some models, listed only as part of retarder assembly (10).

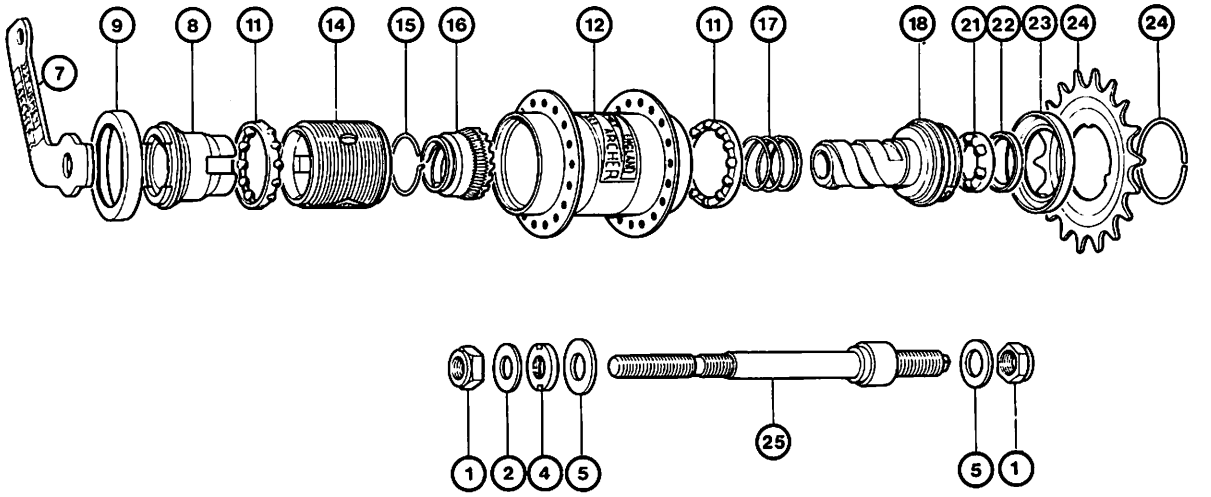
HUBS

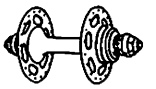
STURMEY ARCHER SC, SC-1, PERRY B-100 TORPEDO COASTER BRAKE

SC



SC1





STURMEY ARCHER SC, SC-1, PERRY B-100 TORPEDO COASTER BRAKE PARTS INTERCHANGEABILITY

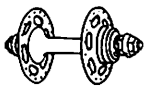
| Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

		SC-1	SC	Perry B-100	Torpedo*
1.	Axle Nut	HMN 118	HMN 118	P 320	0316 061 004
2.	Axle Washer 1/16"	HMW 146	HMW 146		
3.	Axle Washer 1/8"		HMW 129		
4.	LH Brake Arm Nut	HMN 257	HMN 257	P 302	1603 017 100
5.	Plain Washer	HMW 366	HMW 366		2318 004 004
6.	Notched Washer			P 304	
7.	Brake Arm	HSH 424	HSH 424	P 305	0319 101 103
8.	Brake Cone Assembly	HSH 457	HSH 438	P 306	0374 109 100[2]
9.	Brake Cone Dust Cover	HSH 458	HSH 429		0321 001 000
10.	Shell Dust Cover		HSH 439	P 307	0321 002 000
11.	Ball Retainers (2)	HSH 453	HSH 427	P 308	0376 100 000
12.	Hub Shell 28 holes	HSH 460	HSH 423	P 309	
	36 holes	HSH 463	HSH 422		0350 007 111
	40 holes	HSH 465	HSH 421		
13.	Lubricator		HSA 106		
14.	Brake Band	HSH 456	HSH 436	P 310	0373 100 000
15.	Actuator Spring	HSH 455			
16.	Brake Actuator	HSH 454	HSH 440	P 311	0350 052 100
17.	Return Spring	HSH 459			
18.	Driver Complete	HSH 451	HSH 425	P 315 threaded	
	Driver				0372 100 201
19.	Roller Retainer		HSH 430	P 312	0304 001 500
20.	Driver Roller (6.5 mm ϕ)		HSH 428	P 313	0305 001 000
	Circlip				0312 003 000
21.	Inner Ball Cage for Driver	HSA 284			1676 103 100
22.	Dust Cap	HSH 452			1604 013 002
23.	Sprocket Dust Cover	HSH 469	HSL 735	P 316	0321 037 105
24.	Sprocket Sprocket Spacer Washer and Sprocket Circlip[1]			P 314 threaded P 317 threaded	
25.	Axles with fixed cone				
	5¾" (145 mm) non-grooved				0351 100 000
	6" (152 mm) non-grooved	HSH 464			
	6⅛" (155 mm) non-grooved				0351 070 100
	6¼" (159 mm) non-grooved		HSH 419	P 318	
	6 5/16" (159 mm) non-grooved				0351 034 100
	6½" (165 mm) non-grooved	HSH 461			
	6⅞" (175 mm) non-grooved	HSH 462			
	6½" (159 mm) grooved	HSH 467	HSH 420		
	6⅞" (175 mm) grooved	HSH 468	HSH 418		
26.	Fixed Cone		HSH 441		0308 001 100

*Torpedo does sell more individual parts than are listed here.

[1] See Sprocket Interchangability at beginning of Hub section.
[2] Includes brake arm.

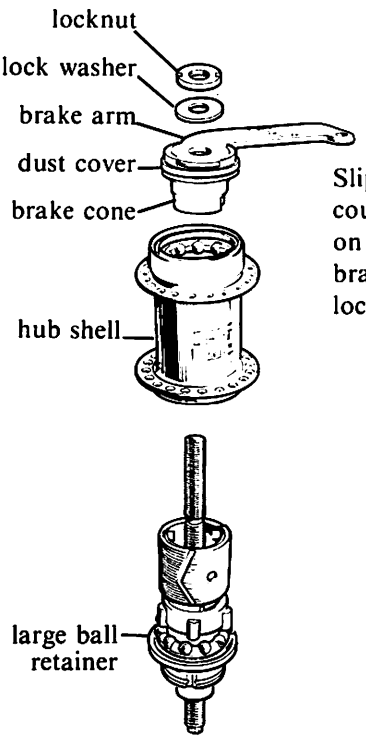


HUBS

STURMEY-ARCHER SC
ROLLER DRIVE COASTER BRAKE
DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove left-hand locknut and lock washer. Unscrew brake cone using brake arm as a wrench. If dust cover and brake arm are press fit on cone, they should not be forced apart. Remove hub shell.



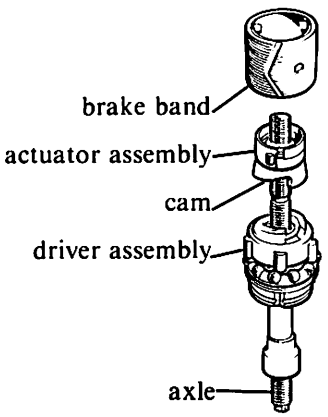
Slip hub shell over assembly. Rotate counter-clockwise until shell race seats on large retainer. Install brake cone, brake arm (brand name facing out) and locknut. Adjust bearing.

ASSEMBLY 2

Next Step

2 DISASSEMBLY

Remove brake band and actuator assembly. Lift off driver assembly.



Next Step

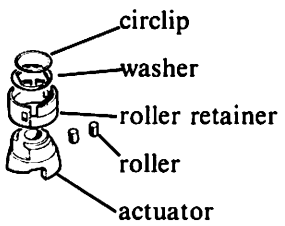
Slip driver assembly over axle so that small ball retainer seats on fixed cone. Install actuator *cam end down*. Position brake band with internal tabs up and press over actuator.

ASSEMBLY 1

DISASSEMBLY

Actuator
With a small screwdriver, ease circlip over the end of actuator body. Remove washer and roller retainer; catch rollers.

SUBASSEMBLIES



Actuator
Stick rollers inside roller retainer slots with grease. Slip round end of roller cover over small end of actuator body. Rollers seat against body flats. Install washer and large circlip.

ASSEMBLY

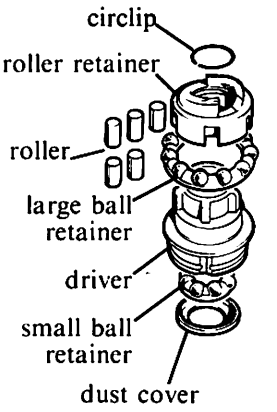
STURMEY-ARCHER SC ROLLER DRIVE COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.) SUBASSEMBLIES

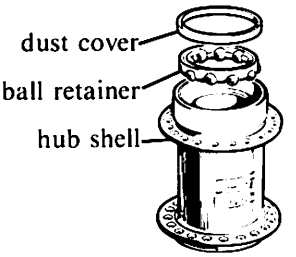
DISASSEMBLY

Driver and Hub Shell

With an awl or small screwdriver ease circlip over end of driver body. Lift off roller retainer and catch rollers.

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.





Hub Shell and Driver

Install large ball retainer with *flat side toward driver race*. Stick rollers in roller retainer with grease. Insert small end of driver through large end of roller retainer. Install circlip.

Install remaining ball retainers *flat side out*. Start dust covers straight and tap home with a soft hammer.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

1. Mating threads of actuator (16) and driver (18) for wear and chipping
2. Surface of driver (18), drive rollers (20) and inside of hub shell for wear and pitting
3. Brake actuator assembly (16) for wear to rollers and roller track
4. Brake band (14) and hub shell mating surfaces for wear or glazing
5. All threaded parts for damaged or stripped threads
6. Dustcaps and bearing retainers for straightness

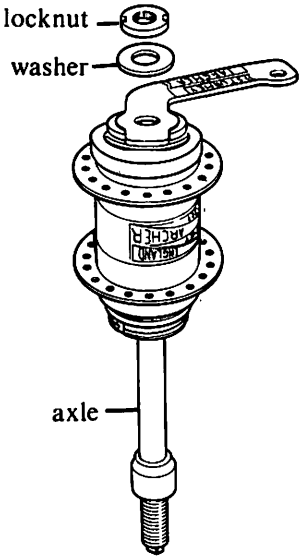
LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake band liberally with a high-temperature grease. Coat other parts with grease.

STURMEY-ARCHER SC1 COASTER BRAKE DISASSEMBLY AND ASSEMBLY

(1) DISASSEMBLY

Remove left-hand locknut and lock washer. Holding driver staionary, unscrew and remove axle.



Turn assembly over.
Install axle from driver side, threading through brake cone. Install lock washer and locknut. Adjust bearing.

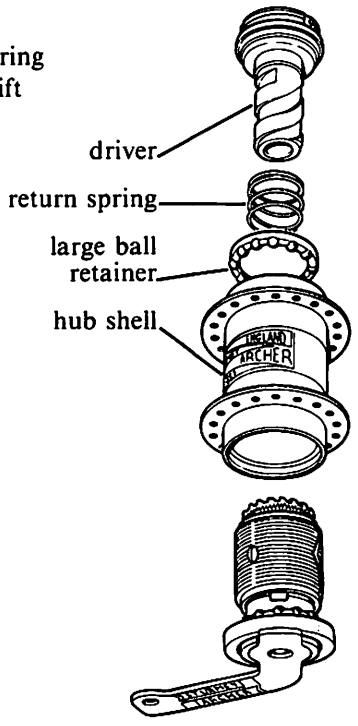
ASSEMBLY (3)

Next Step

Next Step

(2) DISASSEMBLY

Turn assembly over.
Remove driver, return spring and large ball retainer. Lift off hub shell.



Install hub shell *large opening down.*
Insert large ball retainer *flat side up.*
Install return spring and driver.

ASSEMBLY (2)

Next Step
Next Page

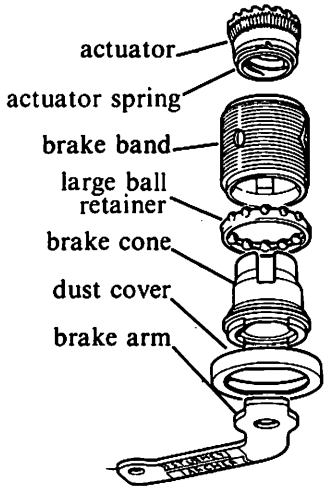
Next Step
Preceding Page

STURMEY-ARCHER SC1 COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Remove actuator. Remove actuator spring only if it is to be replaced. Ease spring over the end of actuator body with a thin bladed screwdriver.

Remove brake band and large ball retainer. Remove brake cone, dust cover and brake arm separately or as a unit. If these parts are press fit together they should not be forced apart.



If separated, press brake cone, dust cover and brake arm together with brake arm imprint facing out. Install large ball retainer *flat side toward dust cover.* Install brake band with internal tabs engaged in brake cone slots. If actuator spring was removed from actuator, install spring with *hooked end clockwise from spring gap* as viewed from small end of actuator. *Incorrect installation will cause excess drag and wear.* Install actuator *small end down* with actuator spring engaged in one of the brake band slots.

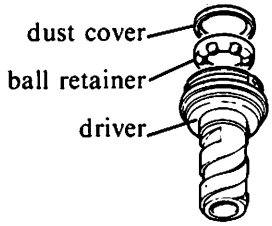
ASSEMBLY 1

SUBASSEMBLY

DISASSEMBLY

Driver

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.



Driver

Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

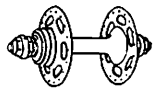
POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

1. Mating threads of actuator (16) and driver (18) for wear and chipping
2. Mating surface of inside of hub shell and outside of actuator (16) for wear and burring
3. Actuator spring (15) for shape and tension
4. Brake band (14) and actuator (16) for wear or burring at mating surfaces
5. Brake band (14) and hub shell mating surfaces for wear or glazing
6. All threaded parts for damaged or stripped threads
7. Dustcaps and bearing retainers for straightness

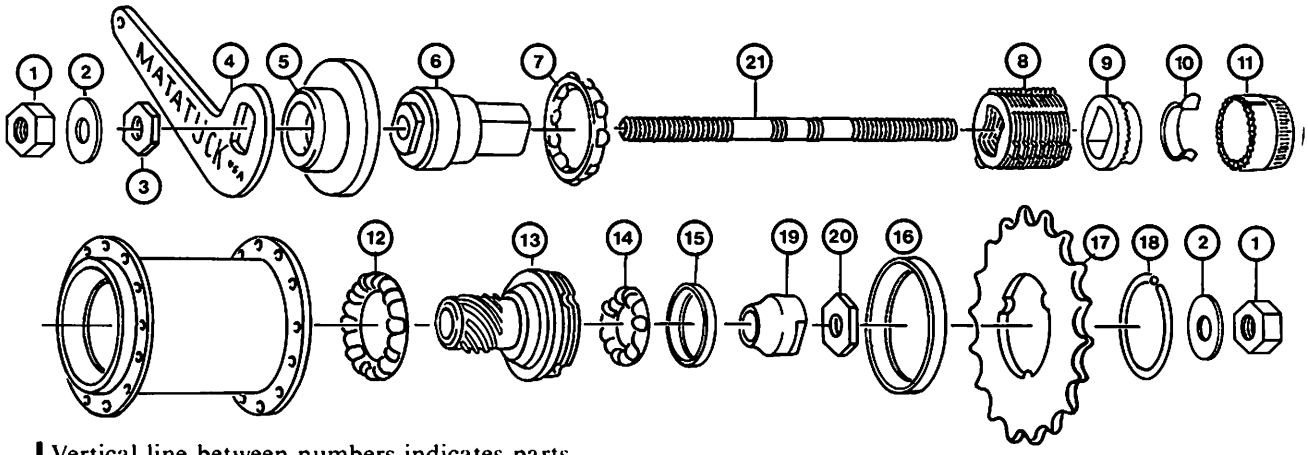
LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake band liberally with a high-temperature grease. Coat other parts with grease.



HUBS

NK, MATTATUCK, NEW DEPARTURE COASTER BRAKES PARTS INTERCHANGEABILITY



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Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

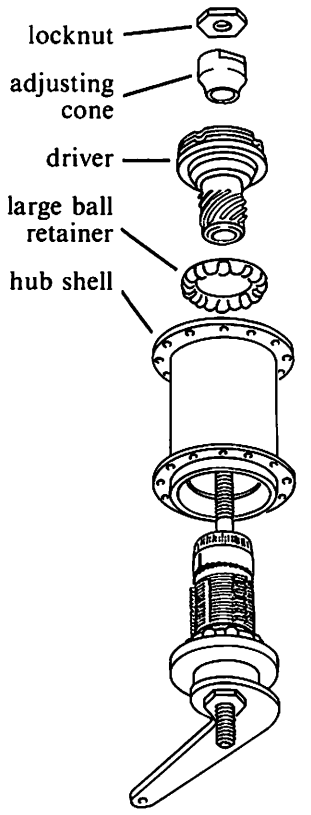
Item #		NK	New Departure	Mattatuck
1.	Axle Nut	NK 88	HD-13	E-13
2.	Washer	NK 87	HD-14	E-14
3.	Arm Lock Nut	NK 82	HD-15	E-15
4.	Brake Arm	NK 75	HD-10	E-10
5.	Dust Cap, brake arm side	NK 80	HD-32	E-32
6.	Brake Disc Holder	NK 68	HD-22	E-22
7.	Ball Retainer	NK 76	HD-16	E-16
8.	Brake Discs (17 discs per set)[1]	NK 723	HD-278	E-278
9.	Brake Clutch	NK 71	HD-6	E-6
10.	Clutch Band (Transfer Spring)	NK 78	HD-12	E-12
11.	Screw Cone (Clutch Sleeve)			
	9 thread	NK 96		
	3 thread	NK 70 (rare)	HD-3	E-3
12.	Ball Retainer (10 - ¼" balls)	NK 76	HD-20	E-16
13.	Driver			
	9 thread (for 3 lug sprockets)	NK 95		
	3 thread (for 3 lug sprockets)	NK 90 (rare)		E-2
	3 thread (for screw-on sprockets)		HD-2	
14.	Ball Retainer (7 or 8 - ¼" balls)	NK 77	HD-20	E-20
15.	Dust Cap, driver[2]	NK 94		E-31-5
16.	Dust Cap, sprocket side	NK 93[3]	HD-31	E-31[3]
17.	Sprocket (threaded)		HD-17	
	Sprocket (3 lug) 20 teeth	NK 921		
	19 teeth	NK 922		
	18 teeth	NK 923		
	16 teeth	NK 925		
	14 teeth	NK 927		
18.	Sprocket Lock Ring	NK 91		E-5-5
	Sprocket Locknut (left threaded)		HD-5	
19.	Adjusting Cone	NK 74	HD-7	E-7
20.	Cone Locknut	NK 99	HD-15[2]	E-15
21.	Axle 6¼"	NK 671	HD-4	E-4
	6¾"	NK 672		

[1] Some New Departure hubs use 21 and 23 discs. Total thickness should be approximately ¾" (19 mm).
[2] On New Departure hubs driver dust cap is part of cone locknut.
[3] These two parts interchange.

NK MULTIPLE DISC COASTER BRAKE DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove right-hand locknut and adjusting cone. Rotate driver counter-clockwise and remove. Remove large ball retainer and lift off hub shell.



Install large ball retainer *flat side up.* Install driver, adjusting cone and locknut. Adjust bearing.

Make sure brake disc tabs are still aligned. Align slots in hub shell with tabs and slip hub over assembly. When hub is correctly seated, brake-arm-side ball retainer is not visible behind dust cap. If hub does not seat properly, lift off and repeat this step.

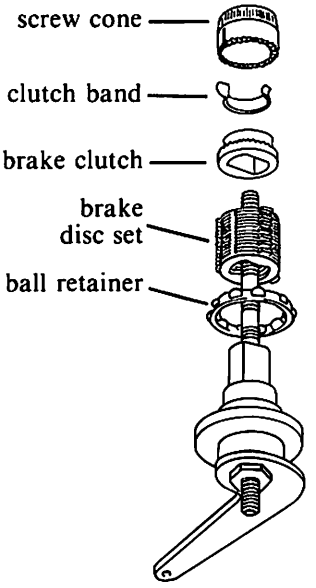
ASSEMBLY 3

Next Step

Next Step

2 DISASSEMBLY

Remove screw cone and brake clutch. Remove clutch band from brake clutch only if necessary. Remove brake discs and ball retainer.



Position axle *brake arm side down.* Install ball retainer *flat side down.* Install one non-turn brake disc over brake holder flats. Install remaining brake discs, alternating tabbed and non-turn discs. Align tabs.
Reinstall clutch band on brake clutch if required. Viewed from above, hooked end of clutch band must be *clockwise* from clutch band gap or excessive drag and wear will result.
Install brake clutch *clutch band up.* Install screw cone with slot engaging hooked end of clutch band.

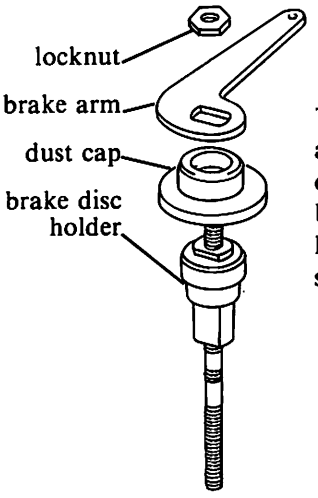
ASSEMBLY 2

Next Step
Next Page

NK MULTIPLE DISC COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Remove brake-end locknut, brake arm, dust cap and brake disc holder.



Next Step
Preceding Page

Thread brake holder onto one end of axle far enough to cover half of ridged central section. Install dust cap and brake arm, *imprinted side out.* Install locknut, tighten while holding brake arm stationary.

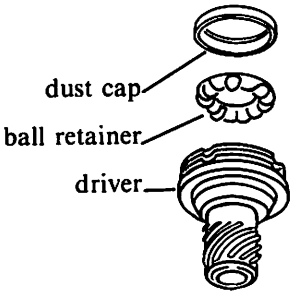
ASSEMBLY 1

SUBASSEMBLY

DISASSEMBLY

Driver

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.



Driver

Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

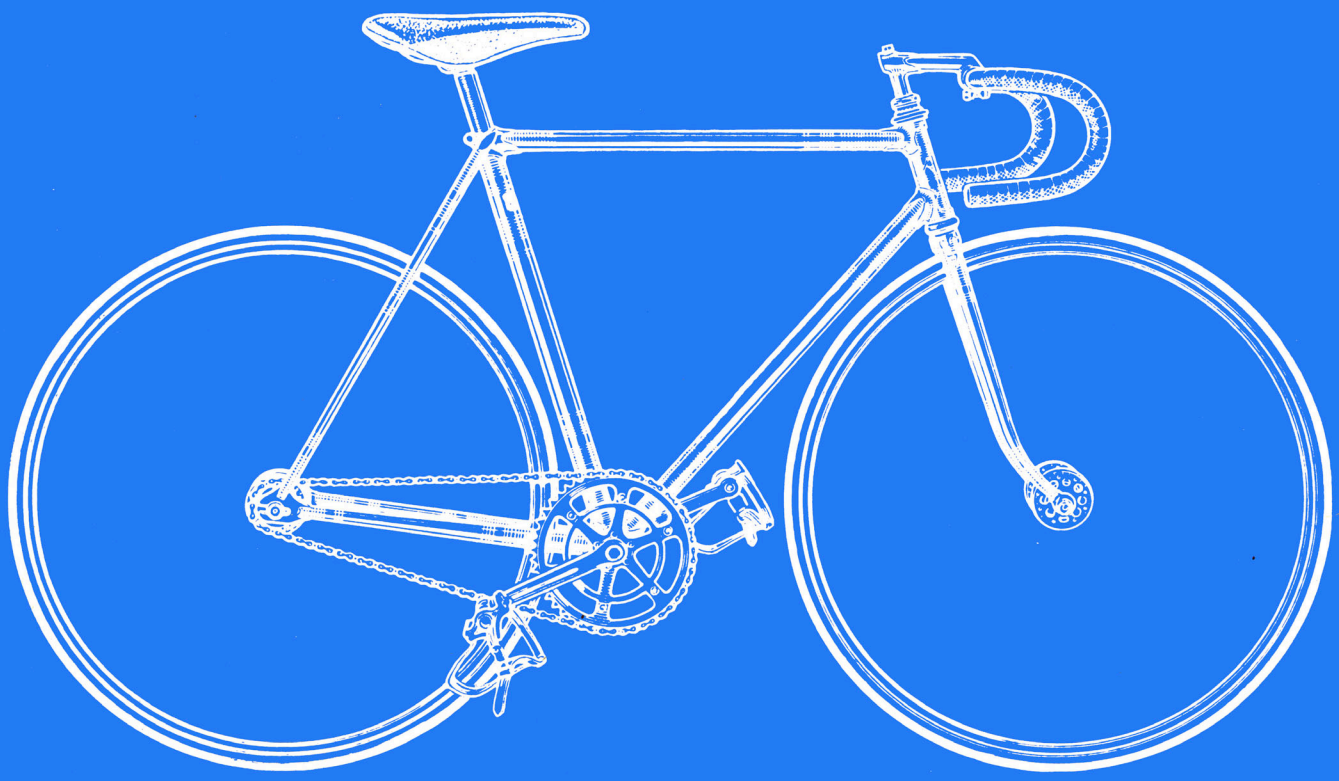
Numbers in parenthesis refer to parts chart and exploded drawing.

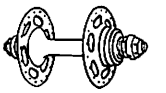
1. Mating threads of screw cone (11) and driver (13) for wear and chipping
2. Conical surface of inside of hub shell and outside of screw cone (11) for wear and burring
3. Clutch band (10) for shape and tension
4. Retarder assembly (9-11) for wear or burring of toothed mating surfaces
5. Brake disks (8) for burring, wear, or excessive polishing
6. Brake disc (8) tabs and flatted holes for wear
7. All threaded parts for damaged or stripped threads
8. Dustcaps and bearing retainers for straightness

LUBRICATION

Lubricate ball retainers by filling the spaces between balls with grease. Lubricate hub shell and brake disc set liberally with a high-temperature grease. Grease other internal parts.

2 Speed Coaster Brakes



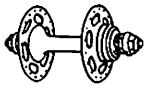


TWO-SPEED COASTER BRAKES

Hub	Trouble Chart page	Parts Interchangeability Chart, Exploded Drawing page	Disassembly and Assembly Instructions page	Cleaning, Points to Check and Lubrication page	Axle Thread Size
Bendix					
Blue Band	8-2	8-4	8-6	8-8	3/8" x 24 TPI
Red Band	8-2	8-4	8-9	8-11	3/8" x 24 TPI
Yellow Band	8-2	8-4	8-6	8-8	3/8" x 24 TPI
F&S Torpedo					
Automatic A2110	8-3	8-12	8-17	8-18	3/8" x 26 TPI
Duomatic 101 (no brake)	8-3	8-12	similar to 102		13/32" x 26 TPI
Duomatic 102	8-3	8-12	similar to R2110		13/32" x 26 TPI
Duomatic R2110	8-3	8-12	8-14	8-16	3/8" x 26 TPI

BRAKE ARM MOUNTING

Coaster brake hubs have a brake arm which prevents the left-hand cone and axle from turning. Attach the brake arm and axle nuts finger tight before cinching down either. Make sure that the brake arm clamp will not pull the brake arm out of line as this will cause severe bearing alignment problems. Tighten axle nuts first, then brake arm clamp.

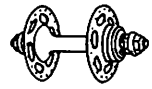


HUBS

BENDIX RED, BLUE & YELLOW BAND 2-SPEED COASTER BRAKES TROUBLE CHART

Symptom	Possible Causes[1] Resulting from wear, improper lubrication or abuse	Resulting from improper assembly or installation
	Dust caps bent	Ball retainer reversed
	Ball retainer damaged or broken	
Binds	Chain too tight	
Makes grinding, cracking or rubbing noise	Damaged or gummed internal parts	
	Cones (6) (24) (28) too tight	
	Axle (16) bent	
Brake does not release	Braking surfaces (29) (8) rough or burred	
	Threads of low-speed driver (33) (20) and clutch (12) damaged	
Brake squeaks	No lubricant	
Poor braking	Braking surfaces (29) (8) glazed or worn	Too few brake discs (8) or discs improperly stacked (Red Band)
Excessive backwards pedal travel	Cones (6) (24) (28) too loose	
	Improper lubrication	
	Teeth on low-speed clutch (12) worn	
No braking (freewheels backward)	Teeth on drive-side expander (30) worn (Yellow and Blue Band)	
	Sprocket loose on driver (33) (18)	
Slips in 2nd gear	Low-speed retarder spring (31) weak	
Slips in 1st gear	Bearing surfaces of low-speed and high-speed drivers (18) (20) (32) (33) worn	
Whines when coasting or driving	Low-speed clutch (12) or hub shell worn	
Jumps from 2nd to 1st, or slips slightly in 2nd	Bearing or tapered surfaces of high-speed clutch (14) and hub shell worn	
	Gear ring on high-speed driver (18) (32) broken loose	
Shifts erratically or does not shift	Fingers on indexing spring (17) damaged	Indexing spring (17) improperly installed
	High-speed retarder spring weak	

[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.



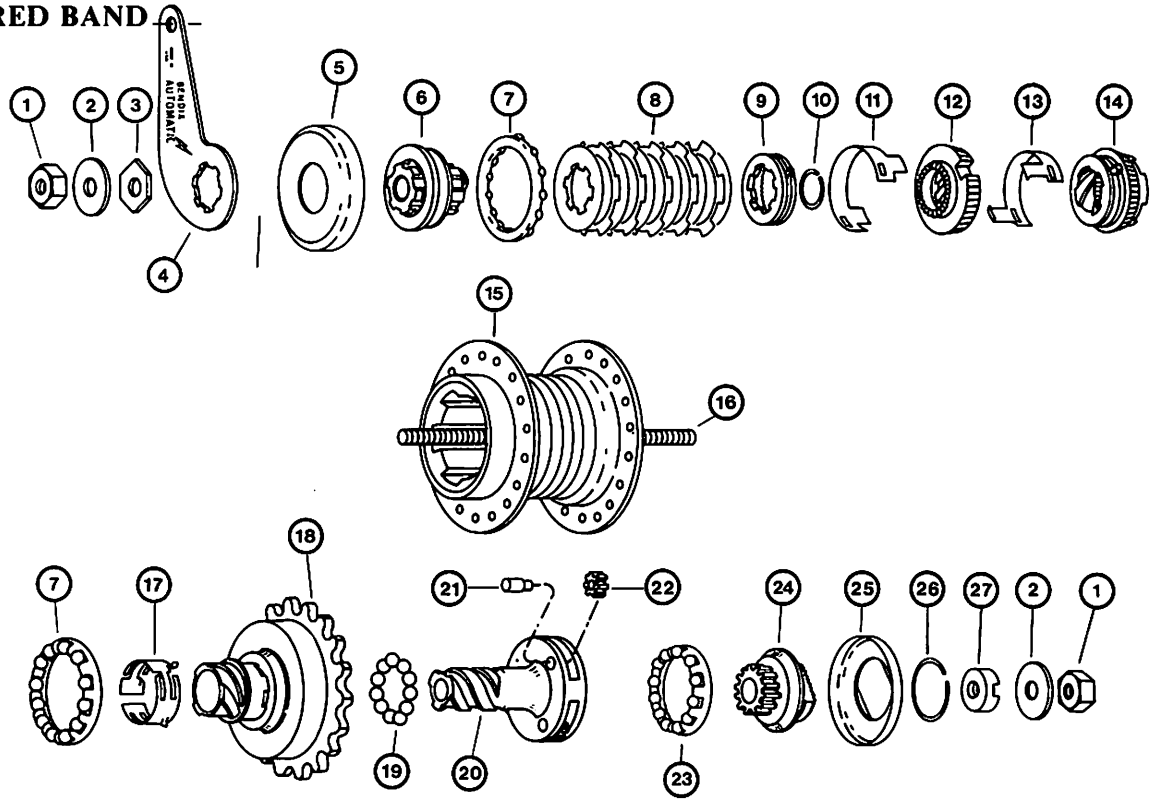
F & S 2-SPEED COASTER BRAKES TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
Slips in 1st gear	Brake cone (8) pawls faulty	Brake cone (8) pawls improperly installed
Slips in 2nd gear	Drive ring (17) or hub shell (7) dogs worn	
Jumps 2nd to 1st	Gear ring (12) pawls faulty	
		Gear ring (12) pawls improperly installed
Stays in 1st gear only (hub turning at same speed as driver)		Flyweights (14) for smaller size wheel
	Flyweights (14) sticking	
Intermittently fails to shift	Control bush (16) friction spring too weak (Duomatic)	
Stays in 2nd gear only (hub turning faster than driver)	Brake cone (8) friction spring too weak	Brake cone (8) friction spring reversed (Automatic)
	Control bush (16) damaged or broken (Duomatic)	Improper friction spring used on brake cone (8) (Duomatic)
Pedals driven forward while coasting	Chain too tight	Ball retainer reversed
	Bearings too tight	Friction spring (9) reversed (Automatic)
	No lubrication or wrong lubrication	
Stiff running, noisy	Ball retainer damaged or broken	
	Brake lever forcing cone out of line	
Jammed	Loose or broken parts inside hub	
	Broken gear teeth	
Too much play in axle	Bearings loose or damaged	
No brake	Brake cone (8) friction spring weak or broken	Brake cone (8) friction spring missing
	Wrong lubricant	
Weak brake	Brake parts glazed or worn	
	Brake lever (4) loose at chainstay	
Brake too strong or jerky	Brake shell (6) unlubricated	
	Axle (28) loose in dropouts	
Brake does not release	Driver bush (13) and brake cone (8) threads worn or chipped	

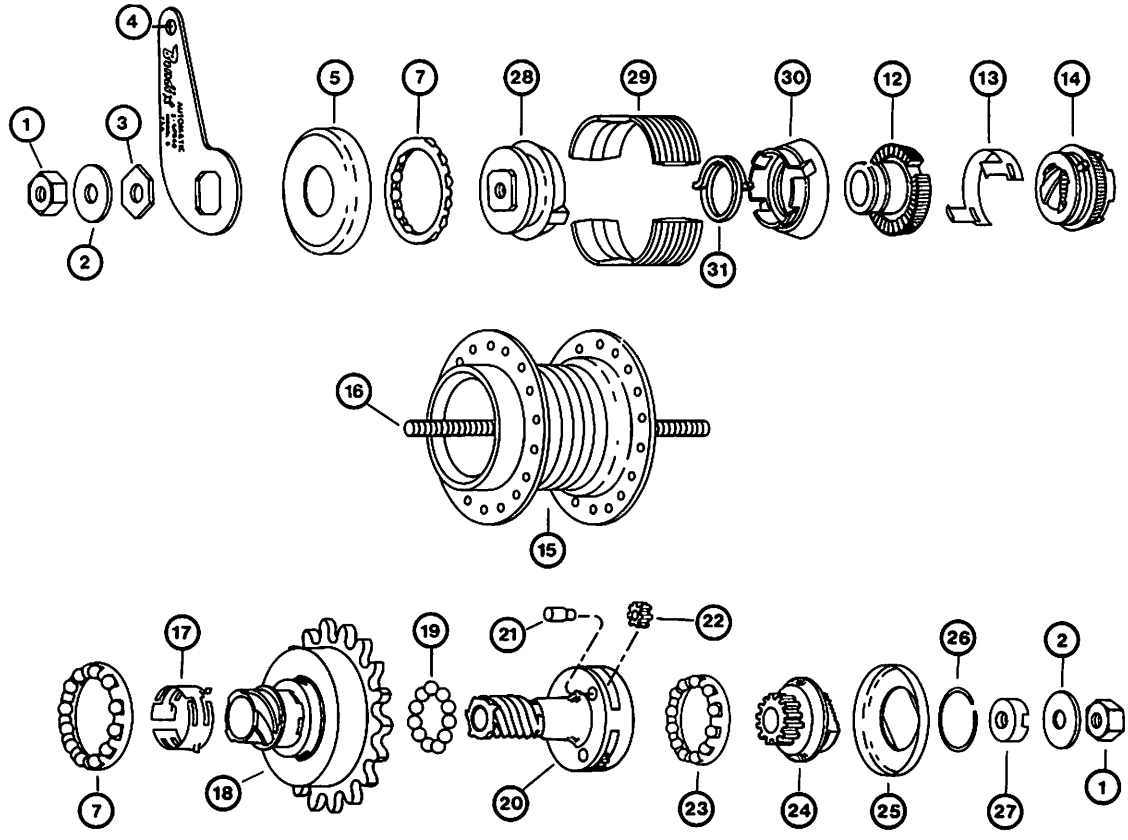
[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.

HUBS

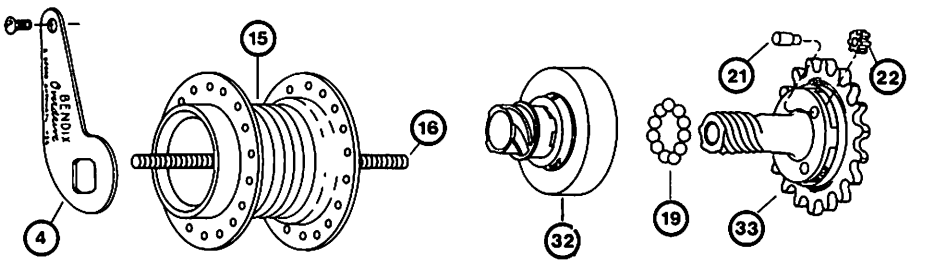
BENDIX 2 SPEED COASTER BRAKE
RED BAND

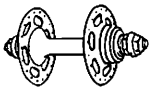


YELLOW BAND



BLUE BAND OVERDRIVE (Parts not interchangable with Yellow Band)



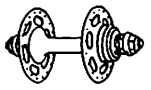


HUBS

BENDIX 2 SPEED COASTER BRAKE PARTS INTERCHANGEABILITY

| Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.	Blue Band Overdrive	Yellow Band Shoe Type Regular	Red Band Disc Type Regular
1. Axle nut	BB-13A	BB-13A	BB-13A
2. Axle washer	BB-14A	BB-14A	BB-14A
3. Locknut, arm side	BB-15	BB-15	BB-15
4. Brake arm	AB-410	AB-310	AB-10 |
5. Dust cap, arm side	AB-331	AB-331	AB-31 |
6. Cone, arm, disc support			AB-33
7. Retainer	AB-16	AB-16	AB-16
8. Disc set			AB-22
9. Pressure plate assembly			AB-6
10. Retaining ring			AB-9
11. Low speed retarder coupling			AB-12
12. Low speed driving clutch	AB-303	AB-303	AB-3 |
13. High speed retarder coupling	AB-21	AB-21	AB-21
14. High speed clutch assembly	AB-23	AB-23	AB-23
15. Hub shell	AB-401	AB-301	
16. Axle	AB-304	AB-304	BB-4 |
17. Indexing spring	AB-26	AB-26	AB-26
18. Sprocket, high speed drive, sleeve assembly, 18 T		AB-318	AB-18 |
Sprocket, high speed drive, sleeve assembly, 19 T		AB-319	AB-19 |
19. ¼" balls, 11 used			
20. Low speed driving screw		AB-302	AB-2 |
Low speed screw assembly (includes driver, gears and pins)		AB-328	AB-28 |
21. Planet gear pin, 3 used	AB-30	AB-30	AB-30
22. Planet gear, 3 used	AB-37	AB-37	AB-37
23. Retainer	AB-20	AB-20	AB-20
24. Adjusting cone sun gear	AB-7	AB-7	AB-7
25. Dust cap, sprocket side	AB-32	AB-32	AB-32
26. Retaining ring, dust cap	AB-41	AB-41	AB-41
27. Locknut, adjusting cone	AB-35	AB-35	AB-35
28. Expander, anchor end	AB-333	AB-333	
29. Shoes, 4 used	AB-322	AB-322	
30. Expander, drive end	AB-306	AB-306	
31. Retarder spring clutch	AB-312	AB-312	
32. Driving screw, high speed	AB-418		
33. Sprocket, driving screw, low speed, 20 T	AB-402		
Sprocket, low speed driving screw assembly, 20 T (with gears and pins)	AB-428		
Clutch pack assembly			AB-45
Retarder subassembly	AB-345	AB-345	
Retarder spring	AB-23A	AB-23A	AB-23A
Offset brake arm for automatic	AB-310A	AB-310A	

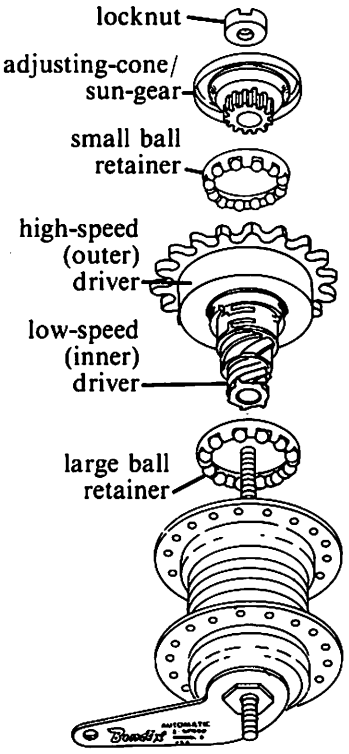


HUBS

BENDIX BLUE AND YELLOW BAND 2-SPEED COASTER BRAKES DISASSEMBLY AND ASSEMBLY

(1) DISASSEMBLY

If possible, put hub in low gear. Remove adjusting cone locknut with Bendix wrench.[1] On underdrive[2] (yellow band) models, turn sprocket clockwise while unscrewing adjusting-cone/sun-gear. On overdrive (blue band) models, hold sprocket stationary. *Coupling can be damaged if sun gear is unscrewed with hub in overdrive.* Thread cone off axle. Lift out small ball retainer. Remove both drivers together to avoid spilling loose balls. Lift out large ball retainer.



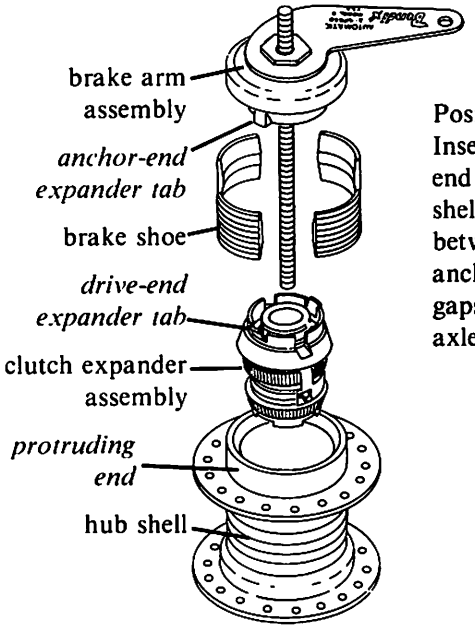
Invert assembly, holding brake arm and hub shell together. Install large ball retainer *ball side down*. Install both drivers as a unit, turning clockwise until seated. Install small ball retainer *ball side down*. Thread on sun gear until it touches planet gears.
Continue turning sun gear clockwise seeing that high-speed (outer) driver rotates counter-clockwise and low speed (inner) driver remains stationary.
Install locknut and adjust bearing so that there is just a trace of side play at wheel rim.

ASSEMBLY (2)

Next Step

(2) DISASSEMBLY

Do not invert assembly. Catch brake shoes as hub shell is lifted off remaining parts. Remove clutch expander assembly.



Next Step

Position hub shell protruding end up. Insert clutch expander assembly small end first. Stick brake shoes into hub shell with grease so that they seat between drive end expander tabs. Line anchor-end expander tabs up with the gaps between brake shoes and insert axle brake arm assembly.

ASSEMBLY (1)

[1] A serviceable substitute can be fashioned from a spark plug by chipping out the center electrode and cutting back the side electrode so that the stub engages locknut slots.

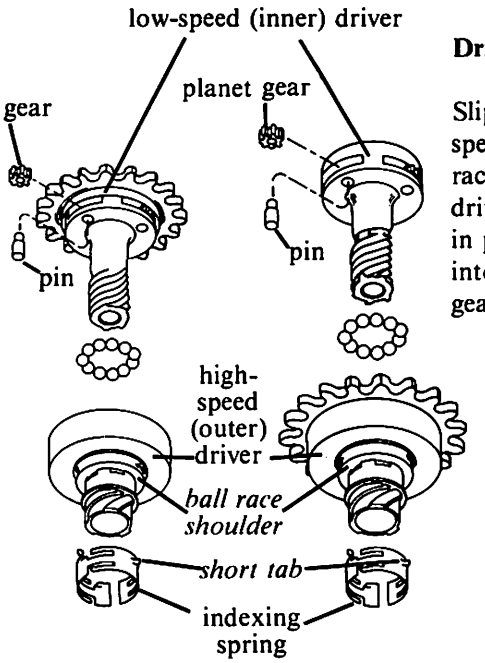
[2] Underdrive models have sprocket on high-speed (outer) driver and should be built up in hub shells with yellow bands, overdrive models have sprocket on low-speed (inner) driver and should only be installed in hub shells marked with blue bands. See driver illustrations on following page.

BENDIX BLUE AND YELLOW BAND 2-SPEED COASTER BRAKES DISASSEMBLY AND ASSEMBLY (cont.) SUBASSEMBLIES

DISASSEMBLY

Drivers

Separate drivers and catch loose balls. Drive out pins and remove planet gears from low-speed driver. Remove indexing spring from high-speed driver.



Blue Band (overdrive) **Yellow Band (underdrive)**

Drivers

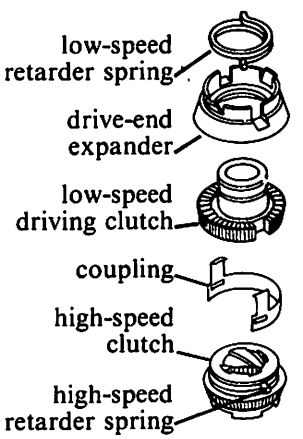
Slip indexing spring over sleeve of high-speed driver with *short* tabs against ball race shoulder. Position planet gears and drive in pins. Stick the 11 loose balls in place and insert low-speed driver into high-speed driver so that planet gears engage gear ring.

ASSEMBLY

DISASSEMBLY

Clutch Expander

Unhook coupling from high-speed clutch retarder spring and from low-speed clutch. Remove high-speed clutch retarder spring only if necessary. Remove low-speed clutch retarder spring and lift off drive-end expander.



Clutch Expander

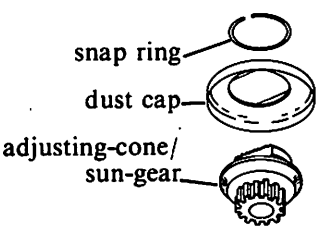
Slip large end of drive-end expander over small end of low-speed driving clutch and replace low-speed retarder spring. Support driving clutch on low-speed driver for this step if necessary. Replace high-speed driving clutch retarder spring if it was removed. Hook coupling over high-speed clutch. *Low* window of coupling engages *low* retarder spring hook. Hook other end of coupling into low-speed driving clutch slots.

ASSEMBLY

DISASSEMBLY

Adjusting-Cone/Sun-Gear

Remove snap ring and lift off dust cover.

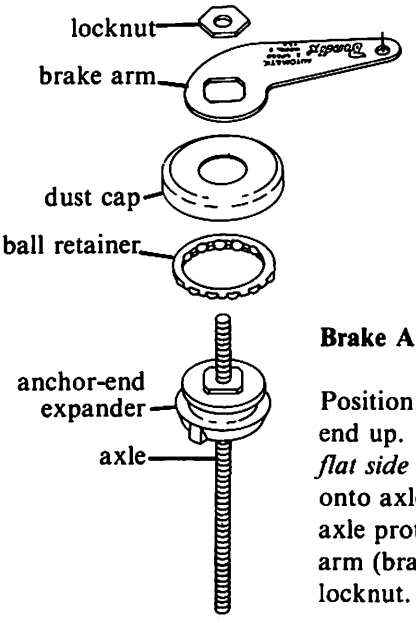


Adjusting-Cone/Sun-Gear

Install dust cover and replace snap ring.

ASSEMBLY

BENDIX BLUE AND YELLOW BAND 2-SPEED COASTER BRAKES DISASSEMBLY AND ASSEMBLY SUBASSEMBLIES (cont.)



DISASSEMBLY

Brake Arm

Remove locknut, brake arm, dust cap and anchor-end expander. Pop retainer over small end of expander with even pressure.

Brake Arm

Position anchor end expander square end up. Use dust cap to pop on retainer *flat side up*. Thread anchor-end expander onto axle with about 1⅛" (29 mm) of axle protruding. Install dust cap, brake arm (brand name facing out) and tighten locknut.

ASSEMBLY

CLEANING -

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

1. Retarder springs (31) (14) and indexing spring (17) for shape and tension
2. Driving clutches (12) (14) for worn teeth or serrations
3. Braking surfaces (29) (15) for wear, glazing and burring
4. Drivers (18) (20) and driving clutches (12) (14) for worn threads
5. Sun gear (24), gear ring (18) and planet gears (22) for worn or chipped teeth
6. Bearing surfaces of both drivers (18) (20), adjusting cone (24), left-hand cone (6) and hub shell (15) for wear and pitting. Replace balls and ball retainers at overhaul.

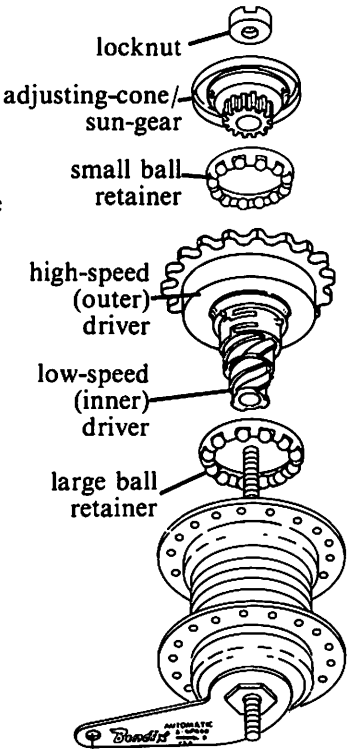
LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Coat other parts with grease.

BENDIX RED BAND 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove adjusting cone locknut with Bendix wrench.[1] Turn sprocket clockwise while unscrewing adjusting-cone/sun-gear. (Hub can be made to remain stationary during this operation by shifting it into low gear.) Lift out small ball retainer. Remove both drivers together to avoid spilling loose balls. Rotate drivers counter-clockwise to disengage from clutch. Lift out large ball retainer.



Install large ball retainer *ball side down.* Install both drivers as a unit, turning clockwise until seated. Install small ball retainer *ball side down.* Thread on sun gear until it touches planet gears.

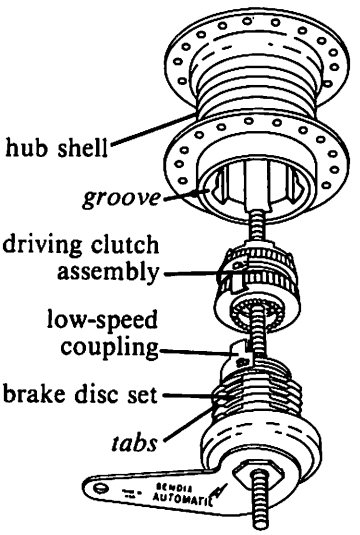
Continue turning cone *clockwise while turning sprocket counter-clockwise.* Install locknut and adjust bearing.

ASSEMBLY 3

Next Step

2 DISASSEMBLY

Lift off hub shell. Remove driving clutch assembly.



Align disc set tabs. Install driving clutch assembly *teeth down.* Slots in clutch engage low-speed coupling tabs. Lower hub shell over assembly being careful to align internal grooves with brake disc tabs. If hub shell will not seat, lift off, re-align tabs and try again.

ASSEMBLY 2

Next Step

Next Step
Next Page

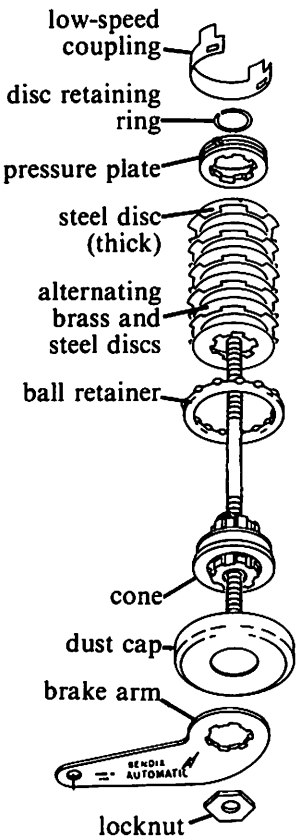
[1] A serviceable substitute can be fashioned from a spark plug by removing the center electrode and cutting back the side electrode so that the stub engages locknut slots.

BENDIX RED BAND 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Remove low-speed retarder coupling. Pry off disc retaining ring with a thin-bladed screwdriver. Lift off pressure plate, brake discs and ball retainer.

Remove locknut, brake arm and dust cap. Thread off left-hand cone.



Next Step
Preceding Page

Thread left-hand cone onto axle until about 1⅛" (29 mm) of axle protrudes. Install dust cap, brake arm and locknut.

Install large ball retainer *flat side toward brake arm.* Install brake disc set, alternating brass and steel discs. If disc set has two *thick steel* discs, use one at each end; if it has one only, install it last. Install pressure plate, disc retaining ring and low-speed retarder coupling.

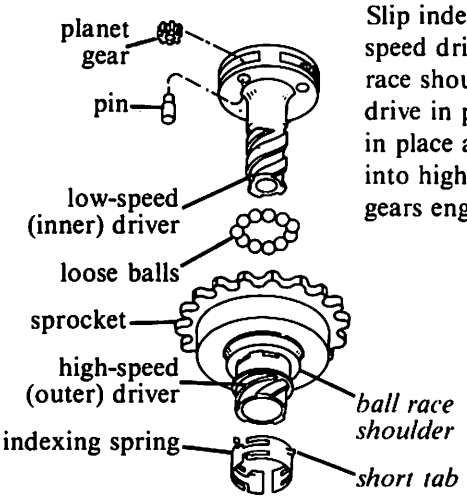
ASSEMBLY 1

SUBASSEMBLIES

DISASSEMBLY

Drivers

Separate drivers and catch loose balls. Drive out pins and remove planet gears from low-speed driver. Remove indexing spring from high-speed driver.



Drivers

Slip indexing spring over sleeve of high-speed driver with *short* tabs against ball race shoulder. Position planet gears and drive in pins. Stick the 11 loose balls in place and insert low-speed driver into high-speed driver so that planet gears engage gear ring.

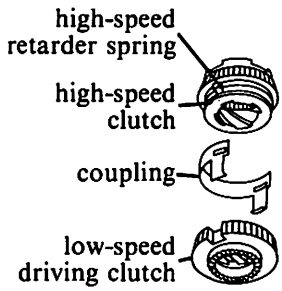
ASSEMBLY

BENDIX RED BAND 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY SUBASSEMBLIES (cont.)

DISASSEMBLY

Driving Clutch

Unhook coupling from high-speed clutch retarder spring and from low-speed clutch. Remove high-speed clutch retarder spring only if necessary.



Driving Clutch

Replace high-speed driving clutch retarder spring if it was removed. Hook coupling over high-speed clutch. *Low* window of coupling engages *low* retarder spring hook.

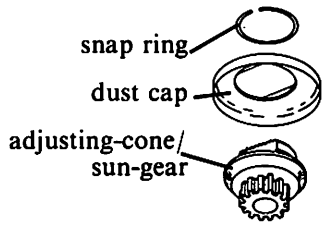
Orient low-speed driving clutch as shown and hook into coupling *with teeth facing out.*

ASSEMBLY

DISASSEMBLY

Adjusting-Cone/Sun-Gear

Remove snap ring and lift off dust cover.



Adjusting-Cone/Sun-Gear

Install dust cover and replace snap ring.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

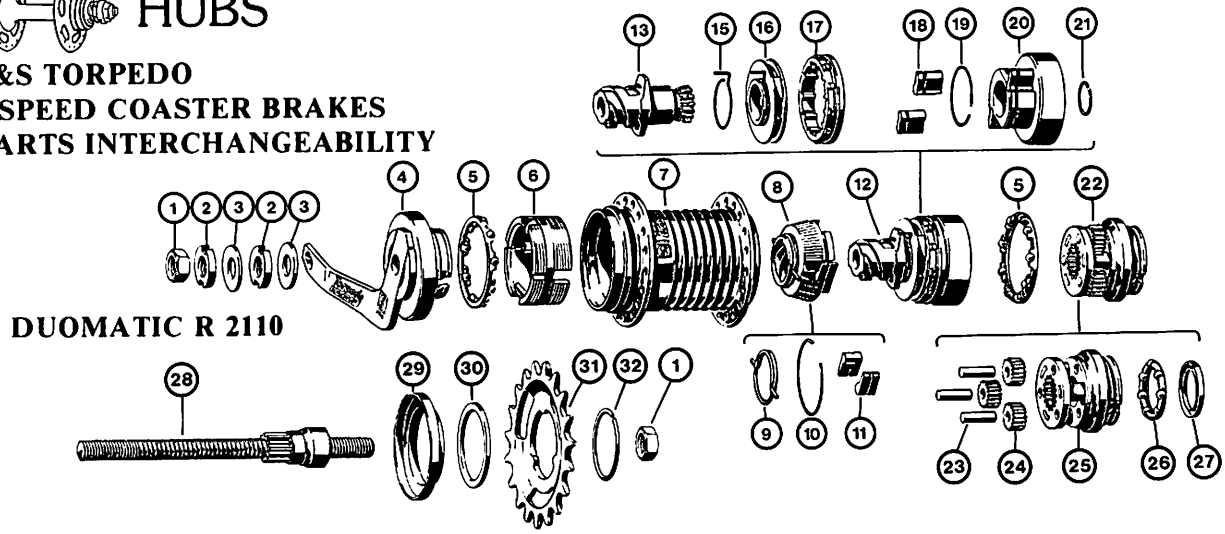
1. Retarder springs (9) (14) and indexing spring (17) for shape and tension
2. Driving clutches (12) (14) for worn teeth or serrations
3. Braking surfaces (8) (9) for wear, glazing and burring
4. Drivers (18) (20) and driving clutches (12) (14) for worn threads
5. Sun gear (24), gear ring (18) and planet gears (22) for worn or chipped teeth
6. Bearing surfaces of both drivers (18) (20), adjusting cone (24), left-hand cone (6) and hub shell (15) for wear and pitting. Replace balls and ball retainers at overhaul.

LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake disc set liberally with a high-temperature grease. Coat other parts with grease.

HUBS

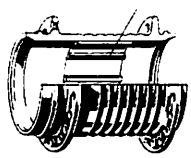
F&S TORPEDO
2-SPEED COASTER BRAKES
PARTS INTERCHANGEABILITY



DUOMATIC R 2110

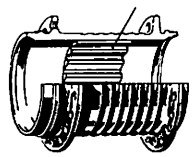
OLD STYLE

Hub shell with
10 trapezoidal teeth
36 holes - 0101 103 100
28 holes - 0101 103 101



NEW STYLE

Hub shell with
18 teeth (saw-toothed)
36 holes - 0101 103 200
28 holes - 0101 103 201



Driving ring (dog ring)
with 10 trapezoidal teeth
0101 104 100

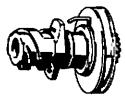
Driving ring (dog ring)
with 9 teeth (saw-toothed)
0101 104 200

Driver bush
0102 107 000

Driver bush with collar
0102 107 100

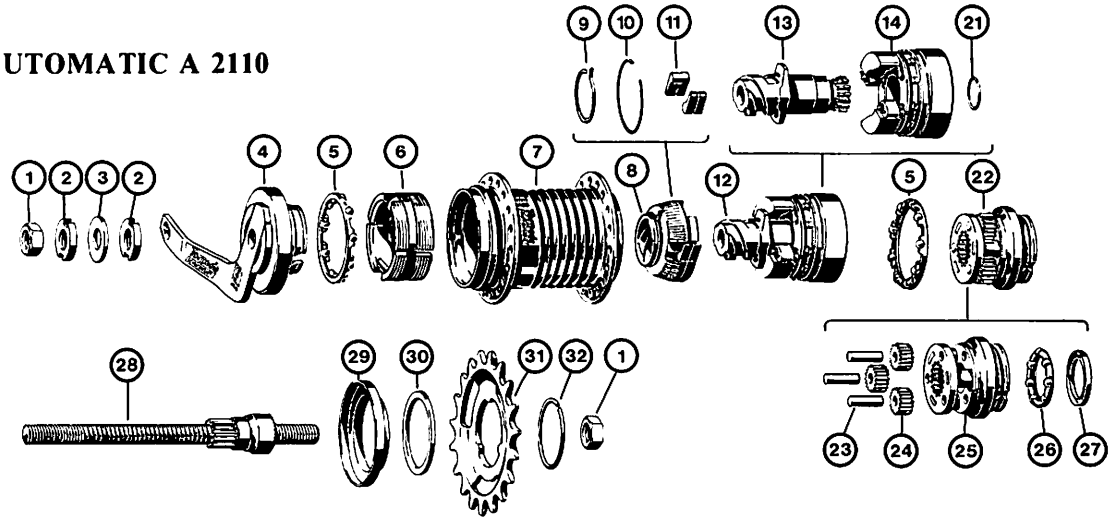
Control bush -
brown, black or tan
0172 109 100
Install only in old style hubs

Yellow control bush with
modified internal section
0172 109 101



New driver bushes combined with new
control bushes can be installed into
hubs of old or new design.

AUTOMATIC A 2110



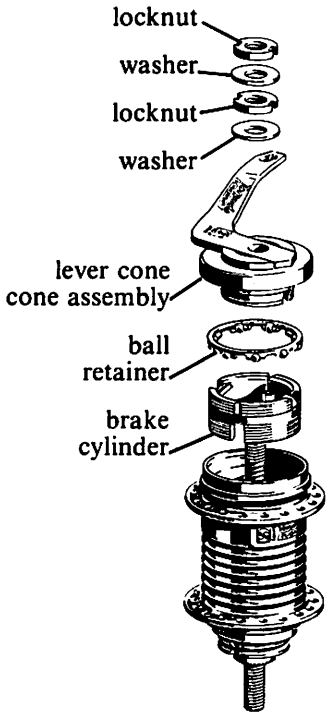
F&S TORPEDO 2-SPEED COASTER BRAKE PARTS INTERCHANGEABILITY	Torpedo Automatic A2110	Torpedo Duomatic R2110	Torpedo Duomatic 102	Torpedo Duomatic 101 without brake
1. Hex Nut	0316 061 004	0316 061 004	0516 003 000[123]	parts in this
2. Lock Nut	1603 017 000	1603 017 000	0516 001 200[123]	column replace
3. Washer	2318 004 004	2318 004 004		parts in the 102
Fixing Plate			0517 102 000[123]	column to make
Lock Washer			0517 003 000[123]	hub without brake
4. Lever Cone Assembly	0174 103 000	0174 103 000	0174 101 000	0574 107 100
Lever Cone			0507 101 100	
Dust Cap			0521 103 100	
Brake Lever			0119 100 100	
5. Ball Cage	0576 104 100	0576 104 100	0576 104 100[123]	
6. Brake Shell (Brake Cylinder)	0573 103 000[2]	0173 102 000	0173 100 000[6]	0173 102 000[4]
7. Hub Shell 36 holes	0101 106 000	see inset	0170 100 000	0101 100 000
28 holes	0101 106 001	see inset	0170 100 001	0101 100 001
24 holes			0170 100 002	0100 100 002
8. Brake Cone Assembly	0574 106 000[1]	0174 101 100	0174 101 000	
9. Friction Spring	0513 102 000[1]	0113 103 000	0113 101 000[6]	
10. Circlip	0512 102 000[12]	0512 102 000[12]	0512 102 000[12]	
11. Pawls (2)	0536 104 000[12]	0536 104 000[12]	0536 104 000[12]	
Brake Cone	0516 101 000[12]		0106 101 000	
12. Driver Bush Assembly		0172 116 000		
for 24"-28" wheels (bare flyweight spring)	0172 113 000			
for 20"-22" wheels (galvanized flyweight spring)	0172 113 001			
13. Driver Bush	0102 105 000	see inset	0102 101 000	
14. Gear Ring Assembly for 24"-28" wheels (bare flyweight spring)	0172 111 000			
Gear Ring Assembly hing for 20"-22" wheels (galvanized flyweight spring)	0172 111 001			
Pawl Carrier Assembly			0172 014 000	
Pawl Carrier			0104 100 100	
15. Friction Spring		0113 100 000	0113 100 000	
16. Control Bush		see inset		
17. Driving Ring (Dog Ring)		see inset	0101 101 000	
18. Pawls		0136 104 000	0136 100 000	
19. Circlip		0112 100 000		
20. Gear Ring		0181 100 000	0133 100 100	
Circlip (2)			0112 101 000	
21. Circlip	0112 103 000	0112 103 000		
Axle Circlip			0517 002 000[123]	
Thrust Washer, small diameter			0518 106 000[123]	
22. Planet Gear Carrier Assembly	0172 105 000	0172 105 000	0172 100 100	0172 100 200
23. Pivot Pins (3)	0114 101 000[1]	0114 101 000[1]	0114 100 000	
24. Planet Gears (3)	0533 103 000[123]	0533 103 000[123]	0533 103 000[123]	
25. Planet Gear Carrier	0172 106 000	0172 106 000	0172 102 100	
26. Ball Cage S 2048	0576 102 000[123]	0576 102 000[123]	0576 102 000[123]	
27. Dust Cap	0121 108 000[123]	0121 108 000[123]	0521 106 000	
Thrust Washer, large diameter			0118 101 000	
28. Axle 148 mm (5.821") 9.5 mm ϕ	0171 103 000	0171 103 000		
158 mm (6.221") 10.5 mm ϕ	0171 106 000	0171 106 000	0109 100 000	
Fixed Cone			0574 105 000	0508 102 000
29. Dust Cap (sprocket side)	0121 109 000[1]	0121 109 000[1]	0121 101 000	0121 108 000
30. Washer (spacer)	0518 018 000[5]	0518 018 000[5]	0518 018 000[5]	
31. Sprockets[5]				
32. Circlip[5]	0512 011 000[5]	0512 011 000[5]	0512 011 000[5]	
Adjusting Cone				0174 100 000
Locking Element				0172 103 000

[1] Interchanges with 3 speed H3111. [2] Interchanges with 3 speed 515. [3] Interchanges with 3 speed 415.
[4] Same as Brake Shell for Duomatic R2110. [5] See Sprocket Interchangability at beginning of Hub section.
[6] See Brake Shell Replacement on Duomatic 102 Hubs, page 00.

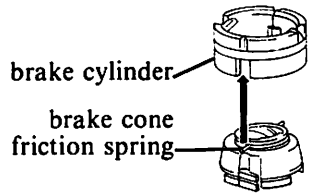
F & S TORPEDO R 2110 DUOMATIC 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove locknuts, washers and lever cone assembly. The brake lever, lever cone and dust cap are press fit together and should not be forced apart. Lift out ball retainer and brake cylinder.



Next Step



Install brake cylinder with internal tabs up. Rotate until slots in brake cylinder engage hooked ends of brake cone friction spring.
Install ball retainer flat side up. Install lever cone assembly. If brake arm, lever cone and dust cap were forced apart inspect carefully. If serviceable, press together with brand name on brake arm facing out. Install assembly with slots on lever cone engaging brake cylinder tabs. Install adjuster locknut, lockwasher and locknut. Adjust bearing, locking the first nut in place with the second.

ASSEMBLY 3

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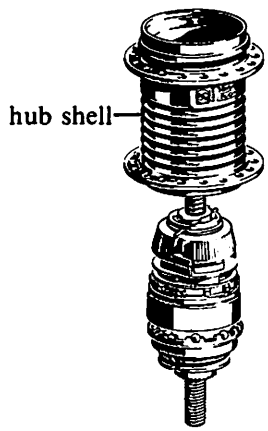
2 DISASSEMBLY

Lift hub shell clear of remaining internal parts



Next Step

Next Step

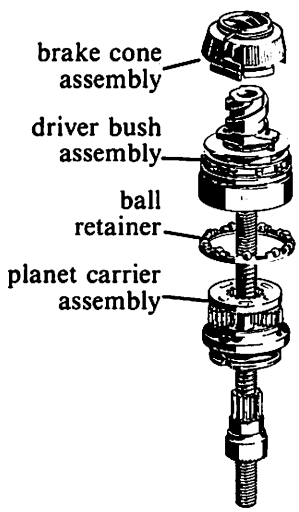
Position hub shell long end up and lower over assembly until it seats.

ASSEMBLY 2

---

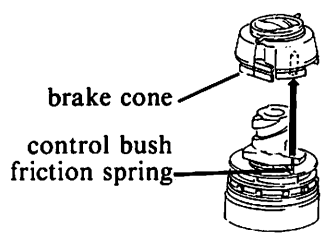
3 DISASSEMBLY

Remove brake cone assembly, driver bush assembly, ball retainer and planet carrier assembly.



Next Step

Assemble brake cone and driver bush. Be sure control bush friction spring fits in the hole in brake cone. Lower this assembly over planet gears.



Install ball retainer flat side down.
Lower planet carrier assembly onto axle.

ASSEMBLY 1

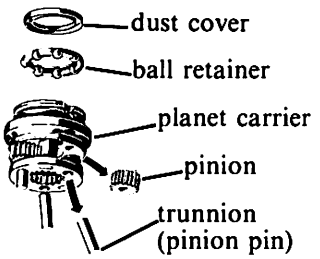
F & S TORPEDO R 2110 DUOMATIC 2-SPEED COASTER BRAKE SUBASSEMBLIES

DISASSEMBLY

Planet Carrier

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

Push out trunnions (pinion pins) and remove pinions.



Planet Carrier

Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

Position pinions and insert trunnions (pinion pins).

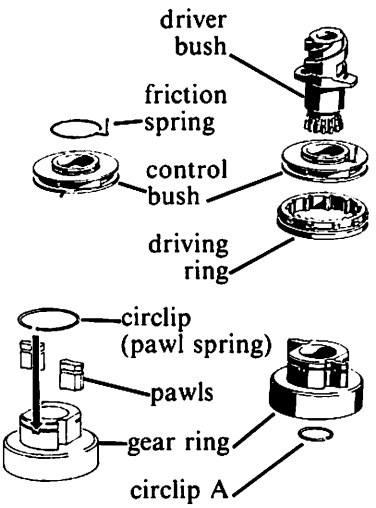
ASSEMBLY

DISASSEMBLY

Driver Bush

Remove circlip A only if it is necessary to disassemble driver bush assembly. Use an awl to ease circlip over driver bush gear.

Remove gear ring pawls and pawl circlip. Remove control bush friction spring only if necessary.



Driver Bush

Replace control bush friction spring if it was removed.

Install gear ring pawls under pawl circlip. Rotate circlip gap over indentation which closes circlip groove. *Viewed as shown, pawls must point counter-clockwise.*

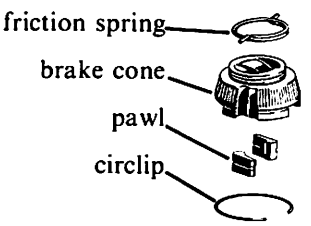
Position driving ring flange down and slip over gear ring. Install control bush, rotating counter-clockwise until it engages pawls. Install driver bush, invert assembly and replace circlip A.

ASSEMBLY

DISASSEMBLY

Brake Cone

Remove friction spring only if it is to be replaced. To remove pawls, pull outward until end of circlip clears groove, then ease circlip off the end of brake cone.

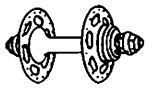


Brake Cone

Install friction spring if it was removed. Use *black* spring only with *bronze* brake cylinder. Use *copper plated* spring only with *steel* brake cylinder.

Install pawls under circlip. Rotate circlip gap over indentations that close circlip groove. Viewed as shown, pawls must point counter-clockwise.

ASSEMBLY



HUBS

F & S TORPEDO R 2110 DUOMATIC 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

1. Driving edges of pawls (18) (11), driving ring (17) and hub shell (7) for worn or chipped corners
2. Teeth on driver bush (12), planet carrier (25), planet gears (24), sun gear (28) and gear ring (20) for wear and chipping
3. Circlips (19) (20) (21) and friction springs (9) (15) for shape and tension. Verify that brake cone has copper plated friction spring for steel brake shell or black friction spring for bronze brake shell. Manufacturer recommends replacing driver bush circlip (A) if it was removed.
4. Bearing surfaces of planet carrier (22), cones and hub shell (7) for wear and pitting. Replace bearing retainers at overhaul.
5. Serrations on brake cone (8) and brake shell (6) for wear
6. Threads on driver bush (13) and brake cone (8) for wear
7. Brake shell (6) and hub shell (7) for wear or glazing of braking surfaces

LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake cylinder liberally with a high-temperature grease. Manufacturer strongly recommends *Sachs Gear Grease* for *bronze* brake shells with *black* friction spring and *Grease for Steel Brake Shells* for *steel* shells with *copper plated* friction spring. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.)

DUOMATIC 102 BRAKE SHELL REPLACEMENT

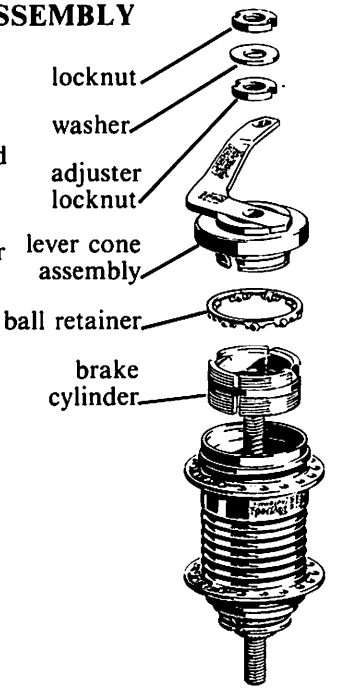
Bronze brake cylinder 0173 100 000 is no longer available. It has been superseded by steel brake cylinder 0173 102 000. *Always* use the correct friction spring and lubricant for the brake cylinder installed, as summarized below.

	Brake Shell	Lubricant	Friction Spring (on Brake Cone)
1.	Steel Brake Shell, Part 0173 102 000	Grease for Steel Brake Shells, Part 0369 135 100	Copper-Plated Friction Spring, Part 0113 103 000
2.	Bronze Brake Shell, Part 0173 100 000	Sachs Gear Grease, Part 0369 111 100	Black Friction Spring, Part 0113 101 000

F & S TORPEDO A 2110 AUTOMATIC 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

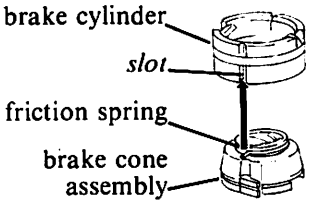
1 DISASSEMBLY

Remove locknuts, washer and lever cone assembly. The brake lever, lever cone and dust cap are press fit together and should not be forced apart. Lift out ball retainer and brake cylinder.



Next Step

Install brake cylinder with tabs up. Rotate until brake cylinder slot engages hooked end of friction spring.



Install ball retainer flat side up. Install lever cone assembly. If brake arm, lever cone and dust cap were forced apart inspect carefully. If serviceable, press together with brand name on brake arm facing out. Install assembly with slots on lever cone engaging brake cylinder tabs. Install adjuster locknut, lockwasher and locknut. Adjust bearing, locking the first nut in place with the second.

ASSEMBLY 3

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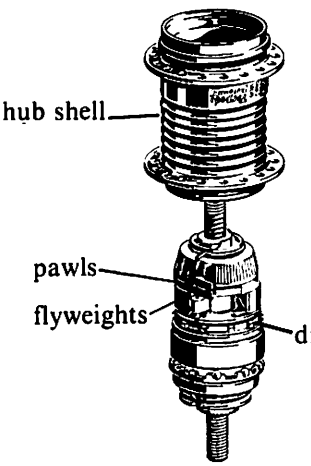
2 DISASSEMBLY

Lift hub shell clear of remaining internal parts



Next Step

Next Step

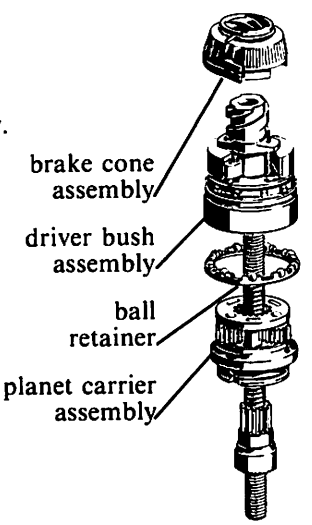
Retract flyweights by turning drive ring counter-clockwise until it rotates freely without clicking. Position hub shell long end up and carefully lower over assembly.

ASSEMBLY 2

---

3 DISASSEMBLY

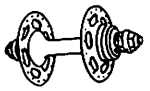
Remove brake cone assembly. driver bush assembly, ball retainer and planet carrier assembly.



Next Step

Lower planet carrier assembly onto axle. Install ball retainer *flat side down*. Slip driver bush assembly over planet carrier. Install brake cone assembly on driver bush.

ASSEMBLY 1



HUBS

F & S TORPEDO A 2110 AUTOMATIC 2-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

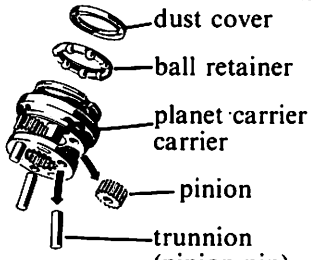
SUBASSEMBLIES

DISASSEMBLY

Planet Carrier

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

Push out trunnions (pinion pins) and remove pinions.



Planet Carrier

Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

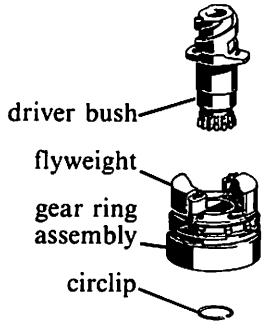
Position pinions and insert trunnions (pinion pins).

ASSEMBLY

DISASSEMBLY

Driver Bush

Remove circlip only to separate driver bush and gear ring assembly. Gear ring assembly is not designed to be disassembled.



Driver Bush

Assemble driver bush, gear ring assembly and circlip.

Flyweight spring rating is indicated by spring finish and a colored dot on one flyweight which should be the same color as the plastic band on the lever cone assembly:

- red for 20-22 inch wheels, spring galvanized;
- blue for 24-28 inch wheels, spring surface untreated.

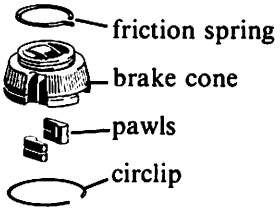
ASSEMBLY

DISASSEMBLY

Brake Cone

Remove friction spring only if it is to be replaced. Ease spring out of groove with a thin-bladed screw driver.

To remove pawls, pull outward until end of circlip clears groove, then ease circlip off the end of brake cone.



Brake Cone

Install friction spring *with hooked end clockwise from gap.* Incorrect installation will cause excess drag, wear and possible brake failure.

Install pawls under straight-ended circlip. Position ends of circlip near indentations that close circlip groove. *Viewed as shown, pawls must point counter-clockwise.*

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

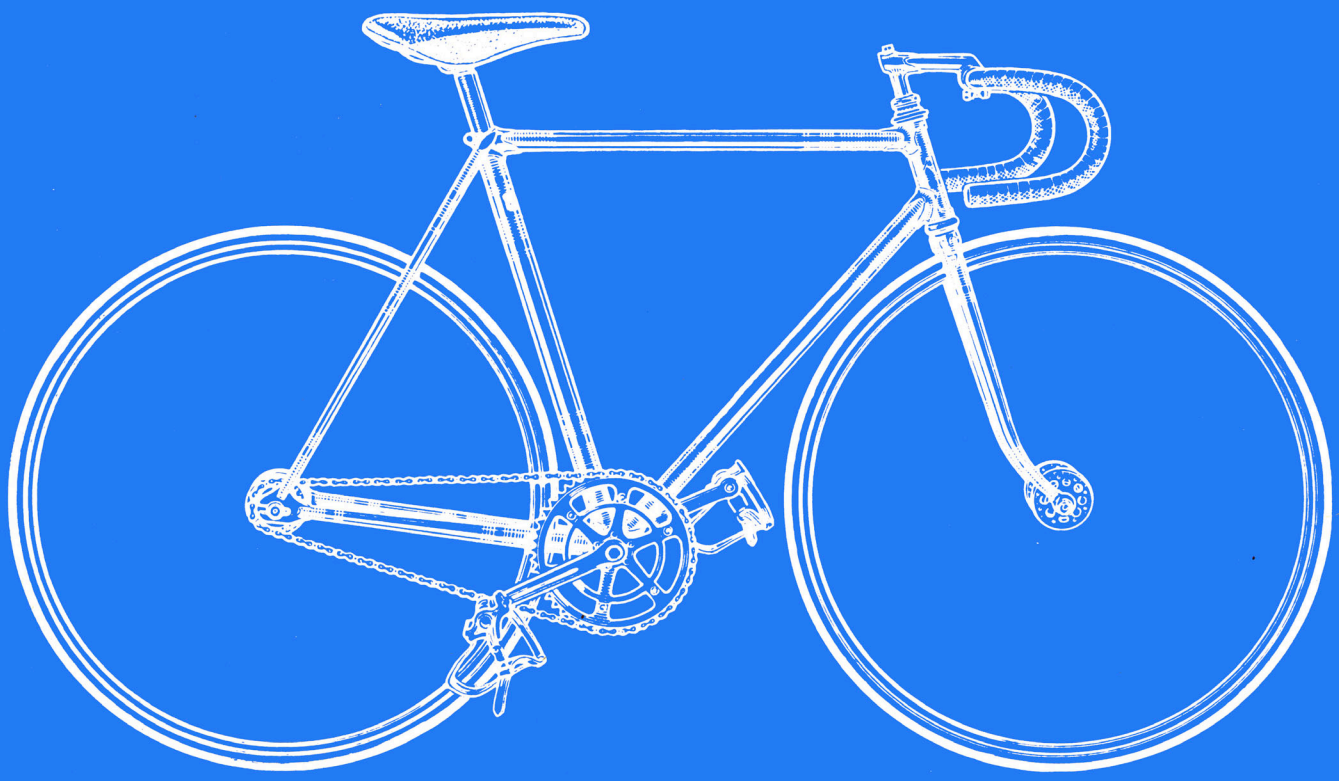
Numbers in parenthesis refer to parts chart and exploded drawing.

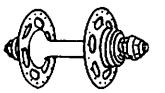
1. Pawls (18) (11), driving ring (14), hub shell (7), driver bush (12), planet carrier (22), planet gears (24), sun gear (28) and gear ring (14) for worn or chipped driving surfaces
2. Circlips (19) (20) (21) and friction spring (9) for shape and tension. Manufacturer recommends replacing driver bush circlip if it was removed.
3. Bearing surfaces of planet carrier (22), cones and hub shell (7) for wear and pitting. Replace ball retainers at overhaul.
4. Serrations on brake cone (8) and brake shell (6) for wear
5. Brake shell (6) and hub shell (7) for wear or glazing of braking surfaces

LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Lubricate hub shell and brake cylinder liberally with a high-temperature grease. Manufacturer strongly recommends *Sachs Gear Grease* for *bronze* brake shells with *black* friction spring and *Grease for Steel Brake Shells* for *steel* shells with *copper plated* friction spring. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.)

3,4 and 5 Speeds



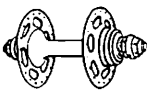


THREE AND FIVE SPEED HUBS

Hub	Trouble Chart page	Parts Interchangeability Chart, Exploded Drawing page	Disassembly and Assembly Instructions page	Cleaning, Points to Check and Lubrication page	Axle Thread Size
Brampton (see Sturmey-Archer AW)					
F&S Torpedo 415	10-5	10-24	see H3111	10-1	13/32" x 26 TPI
Hercules(see Sturmey-Archer AW)					
Schwinn Approved (see Sturmey-Archer AW)					
Shimano					
Cartridge	9-4	9-8	9-14	9-16	3/8" x 26 TPI
F and G	9-4	9-8	9-10	9-13	3/8" x 26 TPI
333	9-4	9-8	similar to F and G		3/8" x 26 TPI
Sturmey-Archer					
AB/C (see AW)					
AG3 (see AW)					
AW	9-5	9-17	9-18	9-21	13/32" x 26 TPI
FW	9-6	9-23	similar to S5		13/32" x 26 TPI
SAB3 (see AW)					
S5	9-6	9-23	similar to S5.1		13/32" x 26 TPI
S5.1	9-6	9-22	9-24	9-27	13/32" x 26 TPI
Styre (see Sturmey-Archer AW)					
Sun Tour (see Sturmey-Archer AW)					

WHEEL MOUNTING

The axle of a multi-speed hub must be firmly held in the dropouts so that it cannot turn. Axle flats, serrated fixing washers or flange nuts and tabbed non-turn washers are used to this effect. Make sure serrated parts seat against the *frame* (not against a washer) and non-turn washer tabs engage dropout slot. If the axle becomes loose in the dropouts it will be necessary to readjust the shift cable.



HUBS

TRIGGER INTERCHANGEABILITY

Shimano triggers are not interchangeable with any others, but all model Shimano hubs use the same trigger. Sturmey-Archer and its imitators all use interchangeable triggers. Two 3-speed triggers can be used with the five-speed hubs instead of the less convenient stem or down-tube shifters sold for them. Adjust the left-hand trigger to operate between 2nd and 3rd positions. A derailleur shifter may also be used for the left-hand shifter, eliminating the need for cable adjustment.

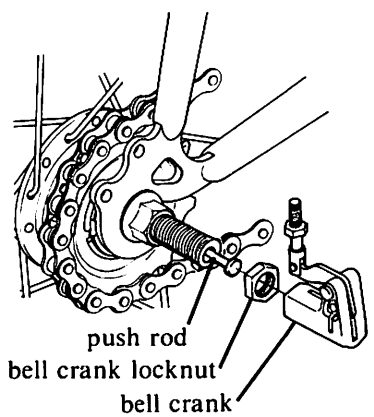
CABLE ADJUSTMENT

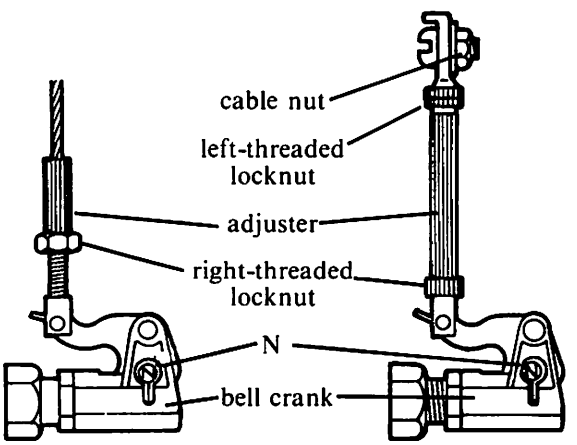
Improper adjustment is the most common cause of problems with 3, 4 and 5-speed hubs. Many people have quit riding a bike because their hub slipped out of gear when they were standing up in the pedals.

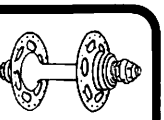
In order to have a hub that is in proper adjustment and *stays* that way, all cable fittings must be tight enough not to creep along the frame, the cable must be free of kinks and knots, the pulley must operate smoothly and bell crank or indicator chain must not be twisted (always back off at least ⅛ turn from finger tight when installing a new bell crank or indicator chain).

Shimano 333, F, G and Cartridge Type

Loosen Bell crank locknut and make sure that bell crank is backed off ⅛ to ⅝ of a turn from finger tight (set screw in the side of the bell crank against the end of axle). Adjust cable so that the circled N on the bell crank paddle is centered in the hole through which it is visible when the trigger is in the *N* position.

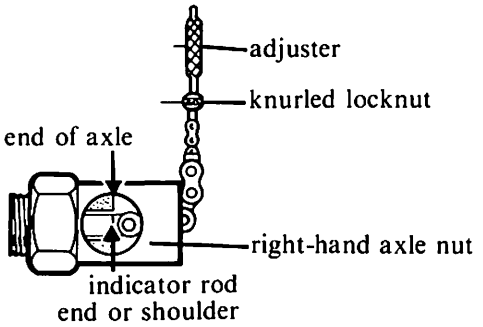






Sturmey-Archer 3-Speeds

Make sure that indicator rod is backed off from 1/8 to 5/8 of a turn from finger tight. Adjust cable so that the end of the indicator rod is just even with the end of the axle with the shifter in the *N* position.[1] This method may not work with a non-standard indicator chain or axle. If it cannot be used, adjust the cable so that the "dead spot" (pedals freewheeling forward) falls exactly half way between *N* and *H* shift trigger positions. This is best done by moving the pedals quickly back and forth with one hand while slowly pushing the trigger from *H* toward *N*. Count indicator chain links as they come out of the axle before the *beginning* of the dead spot; continue moving the pedals and advancing trigger and count the number of links that emerge between the *end* of the dead spot and the click as the trigger goes to *N*. If these two counts are not the same, adjust the cable and try again. In no case should either gear be closer than 1/2 *link* to the dead spot. Tighten knurled locknut against adjuster.



Sturmey-Archer FW (4-speed)

FW hubs use a special 4-speed trigger and indicator chain with a two-piece indicator rod. Hold the indicator chain stationary and make sure the two segments of the indicator rod are tightly screwed together by attempting to tighten the left end (visible in the left end of the hollow axle) with a narrow screwdriver. Adjust the cable so that the *left* end of the indicator rod is even with the *left* end of the axle with the shifter in the *L* position. This only works if the proper length indicator rod is installed for the axle. If in doubt, center the "dead spot" between 3rd and 4th gear as described for the AW.

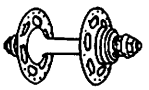
Sturmey-Archer S5, S5.1

Shift left-hand cable to the extended position. Adjust cable until slack. Move shifter to the other position and tighten cable until bell crank or indicator chain stops moving. Right-hand cable can be adjusted like an AW cable, except that it is the indicator rod *shoulder* that lines up with the end of the axle.

F&S

See page 10-2.

[1] If the end of the axle is not visible in the axle nut window, indicator chain will bottom at last link in low gear. Install a spacer under axle nut.



HUBS

SHIMANO F, G and CARTRIDGE TYPE 3-SPEED HUBS TROUBLE CHART

Symptom	Possible Causes[1] Resulting from wear, improper lubrication or abuse	Resulting from improper assembly or installation
3rd gear instead of 2nd	Cable too loose	
2nd gear instead of 1st	No rollers (15)	
Slips in 1st	Driver (31) pawls nearest sprocket faulty, pawl springs weak or broken	Driver (31) pawls or pawl springs nearest sprocket improperly installed
Slips in 2nd	Planet carrier (18) pawls faulty, pawl springs weak or broken	Planet carrier (18) pawls or pawl springs improperly installed
Slips in 3rd	Driver (30) pawls farthest from sprocket faulty, pawl springs weak or broken	Driver (30) pawls or pawl springs farthest from sprocket improperly installed
1st gear instead of 2nd	Cable too tight	
Jumps from 2nd to 1st	Return spring (42) bent or weak	Return spring (42) missing
Sluggish shifting	Left-hand cone (41) misadjusted	
	Axle sun gear (40) chipped or worn	
Jumps from 3rd to 2nd	Ring gear (10) pawls faulty	Cable return spring missing
		Ring gear (10) pawls improperly installed
2nd gear instead of 3rd	----------	Cartridge type driver (30) installed with F type axle (40)

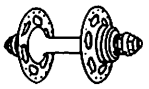
3rd gear only		Right-hand sliding key (39) missing or displaced
Runs stiffly or noisily	One pawl of a pair faulty	Left-hand sliding key (38) (39) missing or displaced
	Axle (40) bent	
	Gear teeth chipped or worn	One pawl of a pair improperly installed
	Dropouts not parallel	
	Improper or no lubrication	F type left-hand cone (41) installed with cartridge type axle (40)
	Loose or broken parts inside hub	Ball retainer reversed
	Chain too tight	
	Gear teeth chipped or worn	
	Cones too tight	
	Ball retainer broken or damaged	

[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.

STURMEY-ARCHER AW 3-SPEED HUB TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
		Low gear pawls (12) installed in gear ring (20) by mistake
		Thrust ring (19) not seated over axle key (16) flats
2nd gear instead of 1st	Clutch spring (32) bent or too long	No washer under right-hand axle nut (31): indicator chain bottoms out at last link
Jumps from 1st to 2nd	Cable too loose	Indicator not fully screwed in
Slips in 2nd	Indicator threads stripped	
	Gear ring (20) dogs worn	
	Clutch (18) worn	
	Pinion pin (15) ends worn	
Jumps from 3rd to 2nd	Gear ring (20) pawls sticking or worn, pawl springs weak or broken	Gear ring (20) pawls or springs improperly installed
Slips in 3rd	Cable too tight	
	Dirt between axle (9) and clutch (18)	
Sluggish shifting	Weak or bent clutch spring (32)	
Slips in 1st	Right-hand cone (5) too loose	
	Cable sticks; indicator chain twisted	
	Planet cage (11) pawls sticking or pawl springs weak	Planet cage (11) pawls or springs improperly installed
	Corroded parts, improper or no lubrication	Spring cap pinched between right-hand cone and driver
	Chain too tight	Too many balls in ball ring (22)
	Cones (5) too tight	One pawl of a pair improperly installed
	One pawl of a pair sticking	
	Chainstay ends not parallel	Ball retainer reversed
Stiff running or noisy	Axle (9) bent	
	Loose or broken parts inside hub	
	Dust caps distorted	
	Ball retainer (7) damaged or broken	

[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.



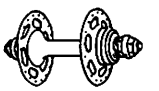
HUBS

STURMEY-ARCHER FW, S5 and S5.1 FOUR AND FIVE SPEED HUBS TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
3rd gear instead of 1st or 2nd		Low gear pawls (12*) installed in gear ring (20) by mistake
		Thrust ring (19*) not seated over axle key flats (14)
Jumps from 1st or 2nd to 3rd	Clutch spring (32*) bent or too long	No washer under axle nut (31*) (1): indicator chain bottoms out at last link
Jumps from 1st or 2nd to 3rd	Cable too loose	Indicator (19) not fully screwed in
Slips in 3rd	Indicator (19) threads stripped	
Slips in 3rd	Clutch (18*) worn	
Slips in 3rd	Gear ring (20*) dogs worn	
2nd gear instead of 1st and 4th instead of 5th	Compensator spring bent, weak, or damaged (FW)	Compensator spring missing (FW)
2nd gear instead of 1st and 4th instead of 5th	Primary sun pinion (10) dogs or axle (13) dogs worn; faulty coiling of low gear spring (12)	
2nd gear instead of 1st and 4th instead of 5th	Left cable too slack (S5, S5.1)	
Slips in 1st gear; Jumps from 5th to 3rd	Pushrod too short (S5)	
Slips in 1st gear; Jumps from 5th to 3rd	Bellcrank paddle slipped past pushrod (S5)	
Slips in 1st gear; Jumps from 5th to 3rd	Left cable too tight (S5.1)	
Slips in 1st gear; Jumps from 5th to 3rd	Weak pinion return spring (7) (S5.1)	Pinion return spring (7) missing
Slips in 2nd gear; Jumps from 4th to 3rd	Dog ring locknut (4) loose (S5,S5.1)	
Slips in 2nd gear; Jumps from 4th to 3rd	Dog ring (6) teeth worn	
Slips in 2nd gear; Jumps from 4th to 3rd	Low gear spring (12) weak	Pinion sleeve reversed (FW,S5)
Slips in 2nd gear; Jumps from 4th to 3rd	Left cable too tight (S5)	Pushrod too long (S5)
Slips in 2nd gear; Jumps from 4th to 3rd	Left cable too slack (S5.1)	

(cont.)
Next Page

[1] Parts numbers followed by * refer to AW parts chart p. 9-17, others to S5 parts chart p. 9-22.



STURMEY-ARCHER FW, S5 and S5.1 FOUR AND FIVE SPEED HUBS TROUBLE CHART (cont.)

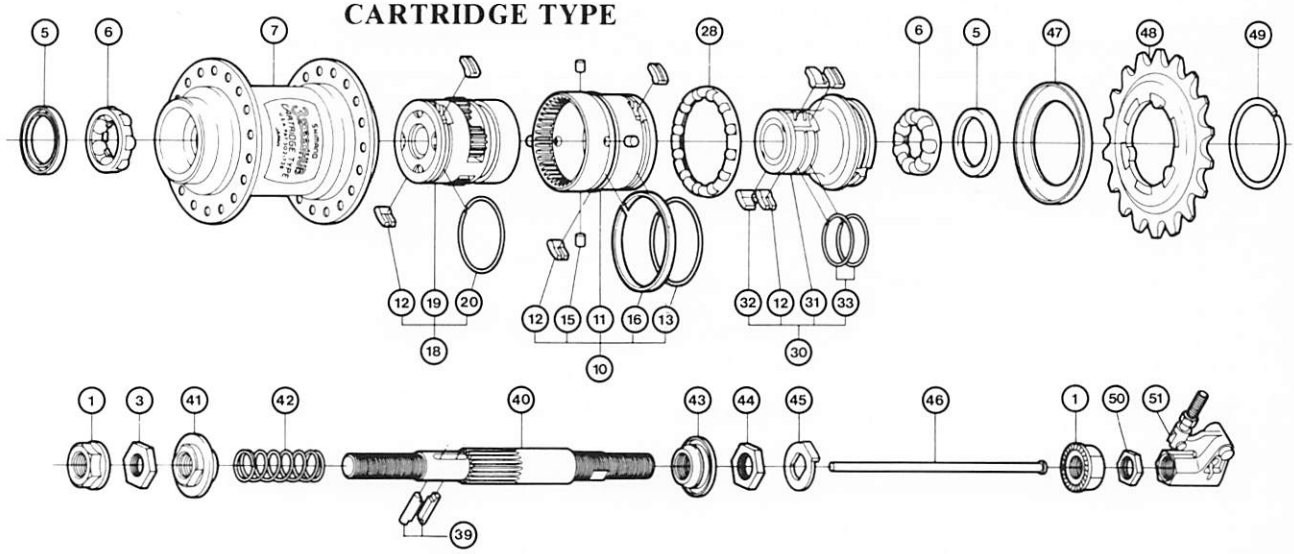
Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
Jumps from 4th and 5th to 3rd	Planet cage (15) dogs worn	
	Clutch (18*) worn	
	Gear ring (20*) pawls sticking or worn	Gear ring (20*) pawls or springs improperly installed
Slips in 4th and 5th	Cable too tight	
	Dirt between axle (13) and clutch (18*)	Clutch spring (32*) missing
	Weak or bent clutch spring (32*)	
Slips in 1st and 2nd	Right-hand cone (5*) too loose	
	Cable sticks; indicator chain (19) twisted	
	Planet cage (15) pawls sticking or pawl springs weak	Planet cage (15) pawls or springs improperly installed
		Wide S3C ball ring (22*) installed in other hub
Stiff running or noisy	Corroded parts, improper or no lubrication	
	Chain too tight	Too many balls in ball ring (22)
	Cones (5*) too tight	One pawl of a pair improperly installed
	Chainstay ends not parallel	
	Axle (13) bent	Planet pinions (16) incorrectly timed (marked teeth must point outward at once)
	Loose or broken parts inside hub	
	Distorted dust caps	
	Ball retainer damaged or broken	
Shifts poorly		Pinion return spring washer (8) missing
	Compensator spring bent, weak or damaged (FW)	
	Dirt between axle (13) and clutch (18*)	
	Clutch spring (32*) weak or bent	
	Right cone (5*) too loose	

[1] Parts numbers followed by * refer to AW parts chart p. 9-17, others to S5 parts chart p. 9-22.

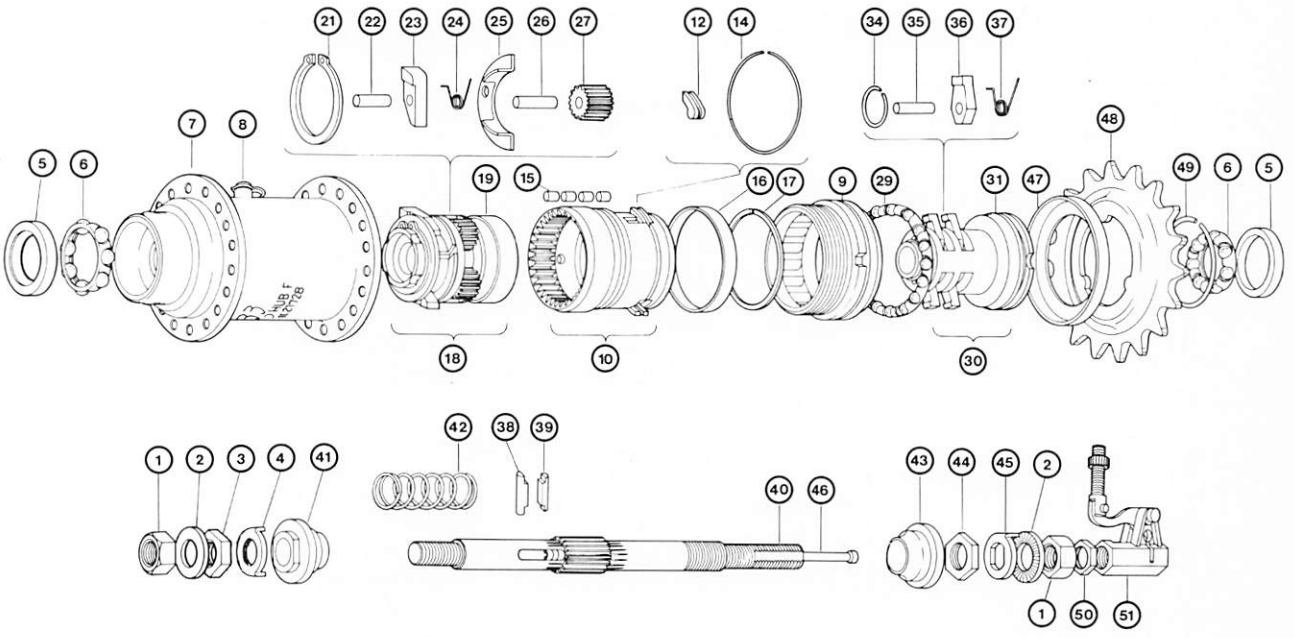
HUBS

SHIMANO F, G and CARTRIDGE TYPE 3-SPEED HUBS

CARTRIDGE TYPE



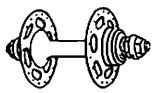
F TYPE & G TYPE



Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

Parts in brackets are interchangeable only as a unit



SHIMANO 3-SPEED HUB PARTS INTERCHANGEABILITY

		Cartridge Type	G Type	F Type	FA Type, 333*
1.	Nut	220 1501-1	321 7000	321 7000	531
2.	Washer	none	200 0500	200 0500	530
3.	Locknut A	321 3800	321 3800	321 3800	529
4.	Cone Stay Washer	none	321 6900	321 6900	528
5.	Dust Cap A	321 2700	321 2700	321 2700	125
6.	Ball Retainer A	321 9022	321 9022	321 9022	124
7.	Hub Shell with Left Cup 28H	322 9001	321 9001	321 9001	
	36H	322 9002	321 9002	321 9002	102
	40H			321 9003	
8.	Lubricator	none	321 0400	321 0400	101
9.	Ball Cup	none	321 5600	321 5600	132
10.	Complete Ratchet A-1- Gear ring	322 9014	321 9012	321 9014	FAA-1
11.	Ratchet A	322 9030			
12.	Pawl A	321 0500-2		321 0500-2	
13.	Ring Spring A (33.5 mm)	322 1100			
14.	Pawl Spring A			321 1100-1	
15.	Roller	321 6200	321 6200	321 6200	217
16.	Roller Cover	322 5900	321 5900	321 5900	218
17.	Snap Ring D		321 2100	321 2100	219
18.	Complete Ratchet B-1- Planet cage	322 9017	321 9017	321 9017	FAB-2
19.	Ratchet B-1	322 9031	321 5800	321 5800	209
	Pawl A (same as Item #12)	321 0500-2			
20.	Ring Spring C (28 mm)	322 1300			
21.	Snap Ring A		321 1800	321 1800	210
22.	Pawl Pin C		321 1000	321 1000	206
23.	Pawl C		321 0700	321 0700	104
24.	Pawl Spring C		321 1300	321 1300	105
25.	Pawl Plate		321 6100	321 6100	211
26.	Pinion Pin B		321 6300	321 6300	208
27.	Planet Pinion		321 5500	321 5500	107
28.	Ball Retainer	321 9081			
29.	Ball Retainer B		321 9023	321 9023	134
30.	Complete Driver	322 9009	321 9009	321 9009	S5
31.	Driver	322 9032	321 7100	321 7100	538
32.	Pawl F	322 0600			
33.	Ring Spring B (19 mm)	322 1200			
	Pawl A (same as item #12)	321 0500-2			
34.	Snap Ring B		321 1900	321 1900	142
35.	Pawl Pin B		321 0900	321 0900	141
36.	Pawl B		321 0600	321 0600	139
37.	Pawl Spring B		321 1200	321 1200	140
38.	Sliding Key B	none	321 2600	321 2600	122
39.	Sliding Key A	321 2500	321 2500	321 2500	120
40.	Axle	322 5200	321 5200	321 5200	521
41.	LH Cone with Dust Cap B	322 9025	321 9025	321 9025	527
42.	Spring	321 3000	321 3000	321 3000	123
43.	RH Cone With Dust Cap B	321 9024	321 9024	321 9024	543, 126
44.	Lock Nut B ($\frac{7}{16}$ x 3)	321 3900	321 3900	321 3900	544
45.	Non Turn Washer	321 6400	321 6400	321 6400	545
46.	Push Rod B	321 7300	321 7300	321 7300	546
47.	Dust Cap	321 2900	321 2900	321 2900	135
48.	Sprocket[1]				
49.	Snap Ring C[1]				
50.	Bell Crank Lock Nut	321 8300	321 8300	321 8300	551
51.	Complete Bell Crank	321 9029-1	321 9029	321 9029	S2

[1] See Sprocket Interchangability at beginning of Hub section.

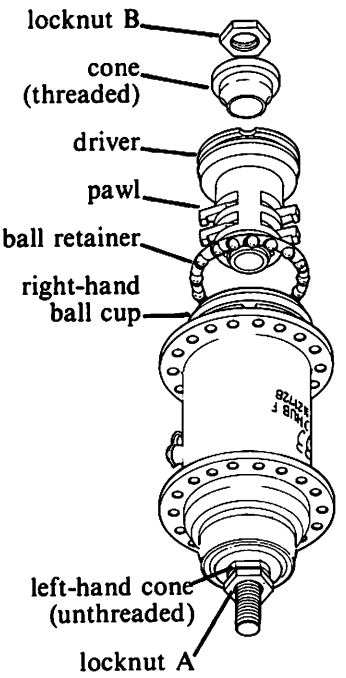
*Old Type 333 hub parts are interchangable with F type except the 2 piece planet cage and 2 piece gear ring. These parts can be replaced as a unit with F-type complete ratchet A-1 and F-type complete ratchet B-1.

SHIMANO F TYPE AND G TYPE 3-SPEED HUBS DISASSEMBLY AND ASSEMBLY

(1) DISASSEMBLY

Remove right-hand locknut (B) and threaded cone. Lift off driver assembly. Remove ball retainer.

Slip Shimano ball cup tool (not shown) over axle to engage right-hand ball cup. Invert assembly, hold tool in vise and turn wheel counter-clockwise to loosen ball cup.



Invert assembly, gripping locknut A in vise and let hub drop down against left-hand cone. Push in protruding ring gear pawls (not visible in drawing) and thread right-hand cup into hub.

Lift hub shell slightly and tighten axle shoulder (not visible) against left-hand cone by turning axle clockwise with a wrench on axle flats. Lower hub shell to seat against left-hand cone.

Install ball retainer flat side up. Rotate driver pawls into operating position (full clockwise, viewed from above) and hold them in against their springs while inserting driver. Install right-hand (threaded) cone, non-turn washer and locknut. Adjust bearing.

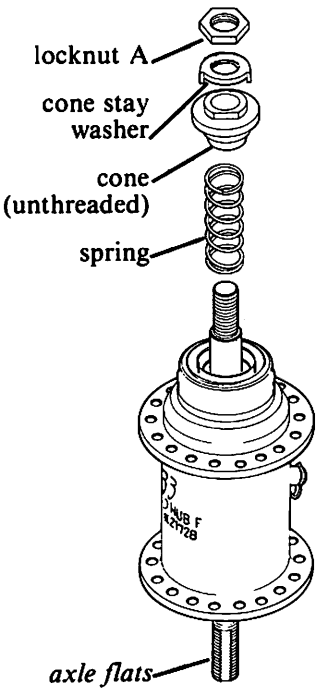
ASSEMBLY 5

Next Step

Next Step

(2) DISASSEMBLY

Invert assembly. Remove left-hand locknut (A), cone stay washer, unthreaded cone and spring.



Slip spring, unthreaded cone and cone stay washer over axle. Hold washer down against spring and thread locknut A on axle *a few turns only*. Note that stay washer tabs engage cone flats.

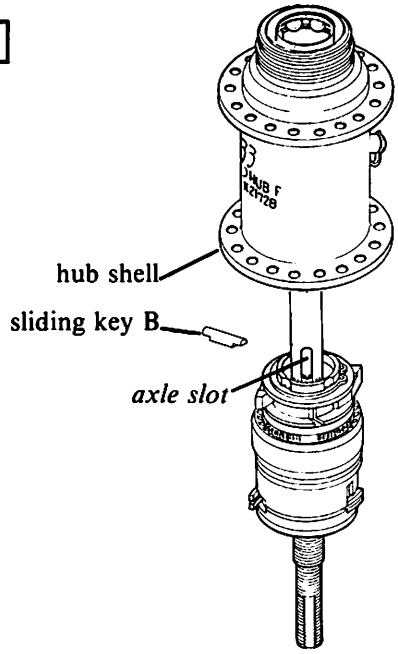
ASSEMBLY 4

Next Step
Next Page

SHIMANO F TYPE AND G TYPE 3-SPEED HUBS DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Lift off hub shell. Remove long sliding key (B) from axle slot.



Next Step

Next Step
Preceding Page

Insert long key (sliding key B) into axle slot, *rounded side up*. Slip hub shell over assembly.

ASSEMBLY 3

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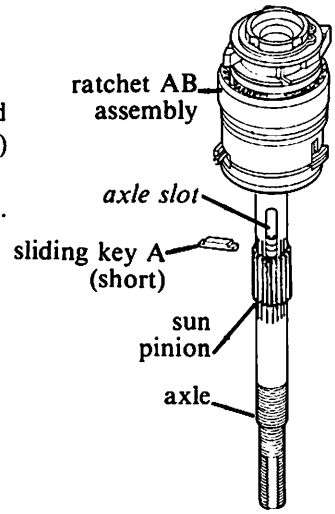
4 DISASSEMBLY

Remove axle from vise and dislodge short sliding key (A) from inside assembly. Separate assembly from axle.



Next Step

Next Step

Clamp axle by flats in vise. Insert short key (sliding key A) into axle slot, *half-round side down.*

Slip ratchet AB assembly over axle. If key interferes with planet pinions, rotate assembly slightly. When properly seated, sun pinion engages planet pinions and key is just visible in axle slot, *flat side up* with both ends covered by planet carrier.

ASSEMBLY 2

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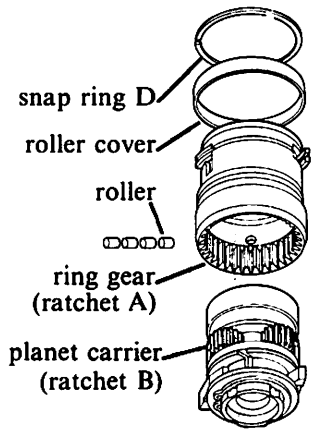
5 DISASSEMBLY

Remove snap ring (D). Holding assembly vertically, lift off roller cover; tap out the four rollers beneath it.

Separate planet carrier assembly (ratchet B) from ring gear assembly (ratchet A)



Next Step

Insert planet carrier assembly (ratchet B) into ring gear assembly (ratchet A) so that planet pinions engage ring gear. Hold unit vertically and install the four rollers, roller cover and snap ring D.

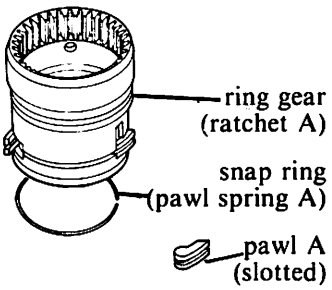
ASSEMBLY 1

SHIMANO F TYPE AND G TYPE 3-SPEED HUBS
DISASSEMBLY AND ASSEMBLY (cont.)
SUBASSEMBLIES

DISASSEMBLY

Ring Gear (ratchet A)

Remove snap ring (pawl spring A) and slotted pawls (A).



Ring Gear (ratchet A)

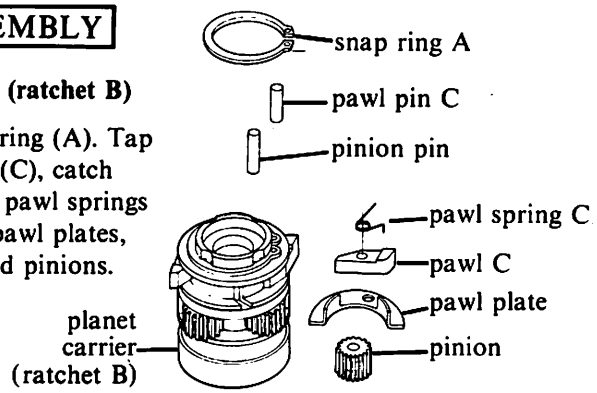
Install slotted pawls (A) and light gauge snap ring (pawl spring A). Position gap in snap ring over break in snap ring groove.

ASSEMBLY

DISASSEMBLY

Planet Carrier (ratchet B)

Remove snap ring (A). Tap out pawl pins (C), catch pawls (C) and pawl springs (C). Remove pawl plates, pinion pins and pinions.



Planet Carrier (ratchet B)

Install pinions and pinion pins. Install pawl plates, aligning plate holes with pawl pin holes. Place pawl spring (C) over recessed area of pawl (C), position over pawl plate and insert pawl pin (C). Install snap ring (A). Be sure snap ring covers pawl pin ends.

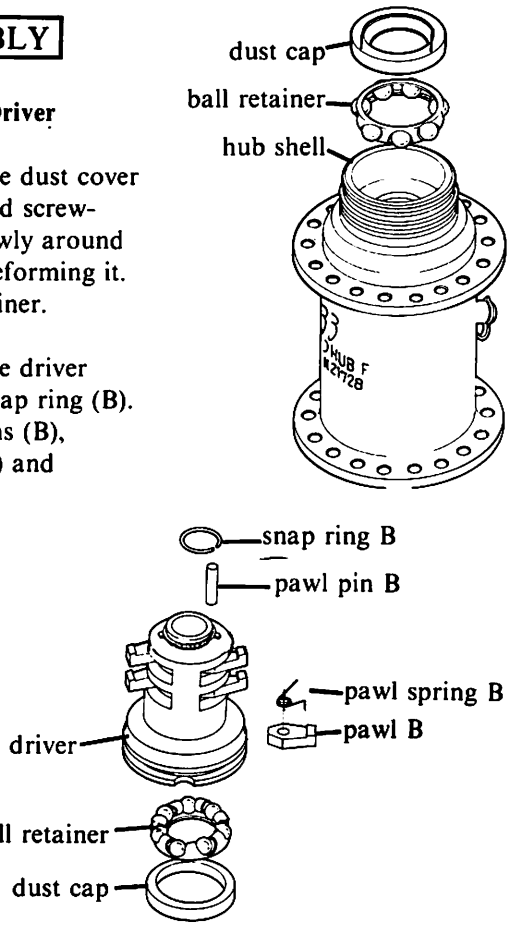
ASSEMBLY

DISASSEMBLY

Hub Shell and Driver

Bearings. Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

Pawls. To remove driver pawls, remove snap ring (B). Tap out pawl pins (B), remove pawls (B) and pawl springs (B).



Hub Shell and Driver

Bearings. Install ball retainer *flat side out*. Start dust cover straight and tap home with a soft hammer.

Pawls. To replace driver pawls, hold pawl springs (B) over recessed area of pawl (B) with hooked end against the *inside surface* of the *long end* of pawl.[1] (Viewed as shown, pawls point *counter-clockwise*.) Insert spring and pawl into first pawl slot and insert pawl pin (B) just far enough to pass through driver flange, pawl spring and pawl. Position second pawl and spring and push pawl pin all the way in. Repeat procedure for remaining two pawls. Replace snap ring (B). Be sure snap ring covers pawl pin ends.

ASSEMBLY

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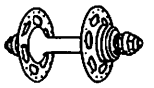
[1] Some older hubs have two driver pawl springs mirror image of those shown. On these hubs two pawl recesses face up, two down.



CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

1. Pawls for worn or chipped corners
2. Ratchets inside hub shell (7), planet carrier (18), ring gear (10) and ball cup (9) for worn or chipped teeth
3. Pinions (27), axle (40), ring gear (10) for worn or chipped gear teeth
4. Return spring (42) and ring spring (14) for size and strength (replace small pawl springs (24) (37) at overhaul)
5. Bearing surfaces of driver (31), right-hand ball cup (9), left-hand ball cup (7), cones (41) (43) and pinion pins (26) for wear and pitting (replace bearing retainers (6) (29) at overhaul)
6. All threaded parts for worn or damaged threads

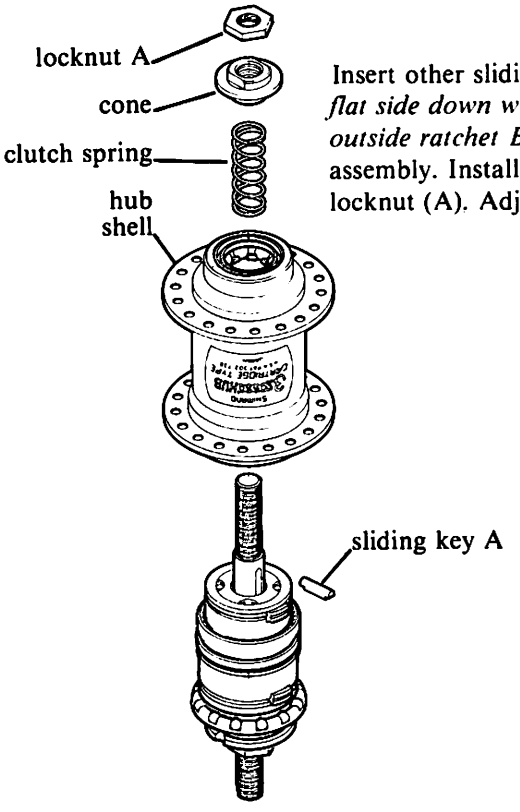
LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Be careful not to grease pawl springs. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

SHIMANO CARTRIDGE TYPE 3-SPEED HUB DISASSEMBLY AND ASSEMBLY

(1) DISASSEMBLY

Remove locknut A, cone and clutch spring. Lift off hub shell. Remove one sliding key (A).



Insert other sliding key (A) into axle slot *flat side down with both ends visible outside ratchet B.* Slip hub shell over assembly. Install clutch spring, cone and locknut (A). Adjust bearing.

ASSEMBLY 2

Next Step

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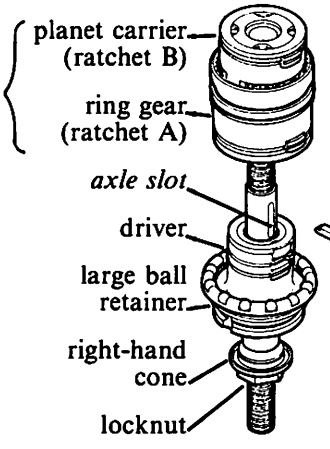
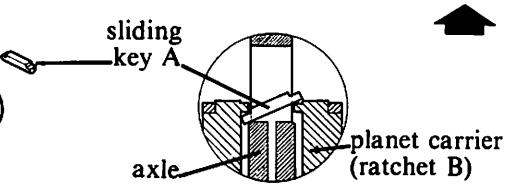
(2) DISASSEMBLY

Next Step



Lift off ratchet AB assembly and dislodge other sliding key (A). Remove large ball retainer and driver assembly. Remove locknut and cone from right-hand end of axle.

Lift driver an additional 1/5" (5 mm) to allow sliding key A to drop into a horizontal position with *both* ends covered by ratchet B. Continue assembly without dislodging this key.

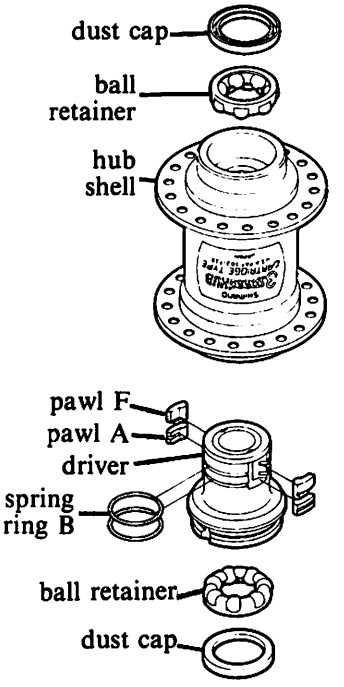


Install right-hand cone and locknut. *Position axle right-hand (hollow) end down* and install driver assembly. Install large ball retainer *flat side down.* Press in driver pawls and install ratchet AB assembly.
Lift driver 1/8" (3 mm) and *insert sliding key A flat side up* as shown, with *one* end covered by ratchet B.

ASSEMBLY 1

SHIMANO CARTRIDGE TYPE 3-SPEED HUB DISASSEMBLY AND ASSEMBLY (cont.)

SUBASSEMBLIES



DISASSEMBLY

Hub Shell and Driver

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

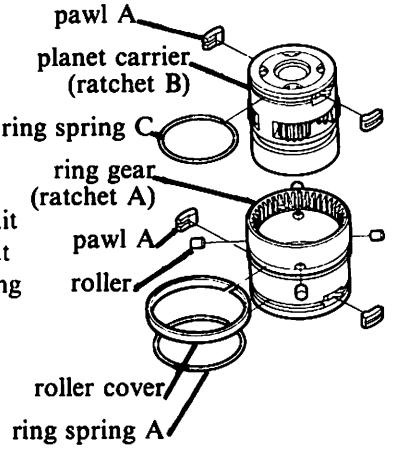
Remove snap ring (ring spring B) and catch pawls (F and A, two each).

ASSEMBLY

Hub Shell and Driver

Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

Position driver large end down. Place an A pawl (center slotted) in one lower socket and start ring spring B in groove. Insert second A pawl and slip spring over pawl to seat in groove. *Driver pawls face counter-clockwise.* Ring spring gap must be positioned over closure in ring spring groove. Repeat for driver F pawls.



DISASSEMBLY

Ratchet AB

Remove A pawls and ring springs A and C. Holding assembly vertical pry off split roller cover. Tilt and tap out the four rollers. Separate ring gear (ratchet A) and planet carrier (ratchet B). Pinions and pinion pins are not designed to be removed.

ASSEMBLY

Ratchet AB

Insert internal ratchet end of planet carrier into ring gear. Install rollers and roller cover.

Position assembly with planet carrier up. Install four A pawls under ring springs A and C. *Pawls must point counter-clockwise.* Ring spring gaps must be positioned over closures in ring spring grooves.

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

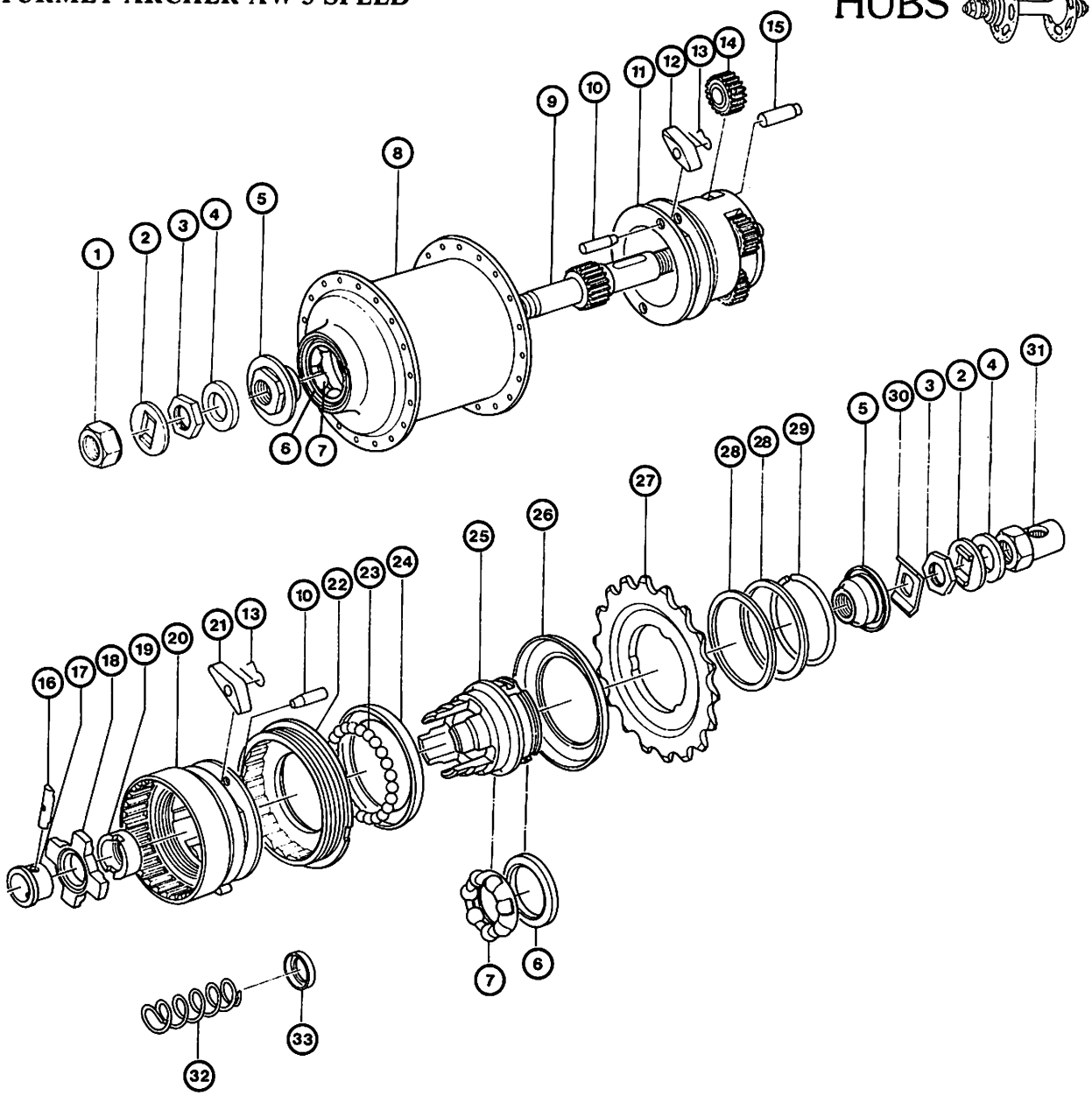
Numbers in parenthesis refer to parts chart and exploded drawing.

1. Pawls for worn or chipped corners
2. Ratchets inside hub shell (7), planet carrier (18) and ring gear (10) for worn or chipped teeth
3. Pinions (27), axle (40) and ring gear (10) for worn or chipped gear teeth
4. Return spring (42) and ring springs (13) (20) (33) for size and strength
5. Bearing surfaces of driver (31), right-hand ball cup (9), left-hand ball cup (7) and cones (41) (43) for wear and pitting (replace bearing retainers (6) at overhaul)
6. All threaded parts for worn or damaged threads

LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Be careful not to grease pawl springs. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

STURMEY ARCHER AW 3-SPEED



1.	Axle Nut	HMN	128	16.	Axle Key	HSA	124
2.	Serrated Lockwasher	HMW	155	17.	Clutch Sleeve	HSA	116
3.	Cone Locknut	HMN	132	18.	Clutch	HSA	117
4.	Washer	HMN	129	19.	Thrust Ring	HSA	283
5.	Cone	HSA	101	20.	Gear Ring	HSA	118
6.	Dust Cap	HSA	102	21.	Pawl for Gear Ring	HSA	119
7.	Ball Cage	HSA	284	22.	Ball Ring RH	HSA	112
8.	Hub Shell Assembly - 40 holes	HSA	104	23.	3/16" Balls		
	36 holes	HSA	105	24	Inner Dust Cap	HSA	122
	28 holes	HSA	239	25.	Driver	HSA	123
9.	Axle 5¾" (146 mm)	HSA	107	26.	Sprocket Dust Cap	HSL	701
	6¼" (159 mm)	HSA	108	27.	Sprocket[1]		
10.	Pawl Pin	HSA	112	28.	Sprocket Spacing Washer[1]		
11.	Planet Cage	HSA	113	29.	Sprocket Circlip[1]		
12.	Low Gear Pawl	HSA	111	30.	Cone Lockwasher	HMW	147
13.	Pawl Spring	HSA	120	31.	RH Axle Nut	HMN	129
14.	Planet Pinion	HSA	115	32.	Clutch Spring	HSA	128
15.	Pinion Pin	HSA	114	33.	Cap for Clutch Spring	HSA	129

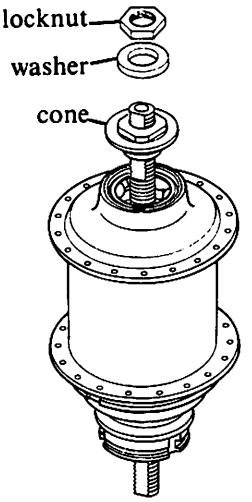
[1] See Sprocket Interchangability at beginning of Hub section.

HUBS

STURMEY-ARCHER AW 3-SPEED HUB DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove left-hand locknut, washer and cone.



Turn assembly over.
Install cone, lockwasher and locknut.
Adjust bearing.

ASSEMBLY 5

Next Step

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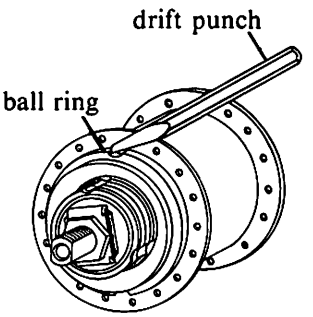
2 DISASSEMBLY

Next Step

Turn assembly over.
The right-hand ball ring may have a double start thread. If the ball ring is replaced in the opposite position, the wheel may need retruing. To facilitate proper reassembly, mark the ball ring at the point nearest lubricator.

Place a drift punch as shown and loosen the ball ring by rapping the punch firmly with a hammer.



Turn assembly over.
When correctly oriented, tighten with a hammer and drift punch.

ASSEMBLY 4

Next Step

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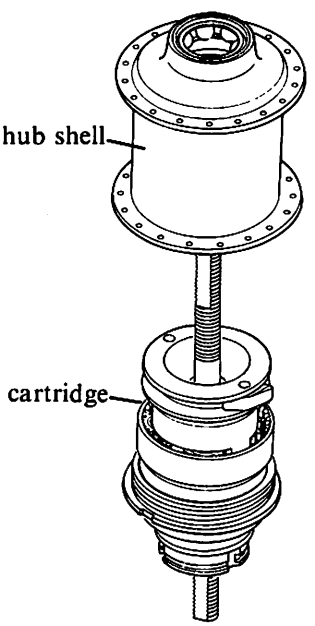
3 DISASSEMBLY

Next Step

Unscrew right-hand ball ring completely and remove the cartridge from the hub shell.



Thread cartridge finger tight into hub. If the mark made during disassembly is not next to the lubricator, remove and restart.

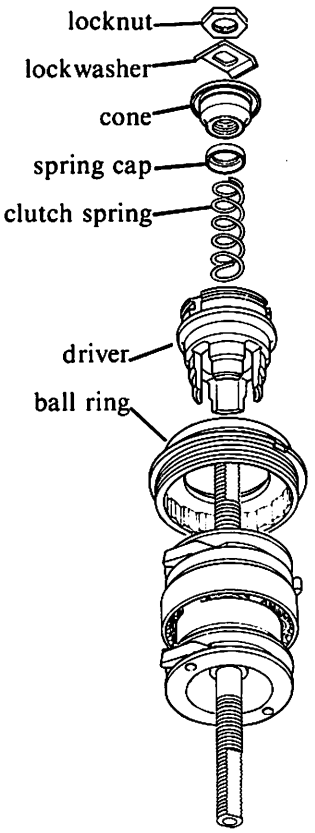
ASSEMBLY 3

Next Step
Next Page

STURMEY-ARCHER AW 3-SPEED HUB DISASSEMBLY AND ASSEMBLY (cont.)

4 DISASSEMBLY

Remove right-hand locknut, lockwasher and cone. Remove clutch spring, cap and driver.[1] Remove ball ring and gear ring.



Next Step
Preceding Page

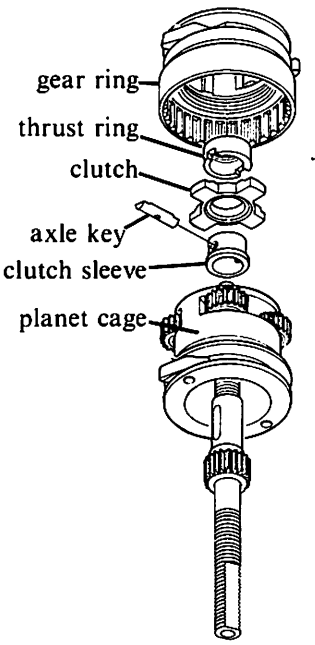
Install ball ring. Install driver, clutch spring and spring cap.[1]
Install cone, lockwasher and locknut. Adjust bearing. If bearing runs rough, check spring cap.[1]

ASSEMBLY 2

Next Step

5 DISASSEMBLY

Lift off gear ring. Remove thrust ring.[2] Push out axle key. Remove clutch sleeve. Remove planet cage.



Next Step

Replace planet cage. Install clutch sleeve *flange down*. Install clutch with tabs flush against planet cage. Insert axle key through both clutch sleeve and axle slot with flats facing up. Install thrust ring.[2] *Notches in thrust ring must engage axle key flats.* Replace gear ring.

ASSEMBLY 1

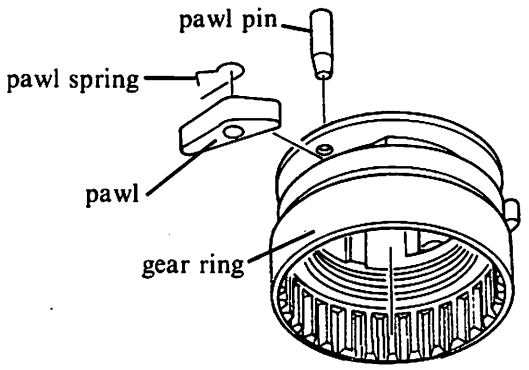
[1] Old model spring caps are too large to fit through the driver. On these hubs, the spring and cap are removed *after* and installed *before* the driver. Otherwise the spring cap will be compressed between the cone and the bearing with damage to both. Upon installation the driver must be held in place against the spring until the cone is installed.

[2] If thrust ring has top and bottom openings of *equal* diameter it must have a thrust washer on top of it.

DISASSEMBLY

Gear Ring

Remove pawl pins, pawls and springs. Be careful not to lose pawl springs.



Gear Ring

Place spring in position on top of gear ring (large) pawl with hooked end bearing on the *inside surface* of the *long end* of pawl. Slide spring and pawl into slot and insert pawl pin *tapered end first.* Make sure spring is hooked around pin. Test pawl operation and repeat for other gear ring pawl.

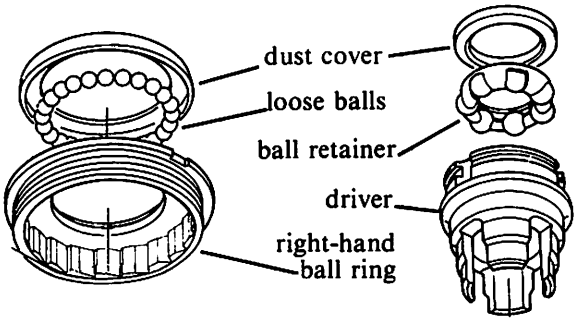
ASSEMBLY

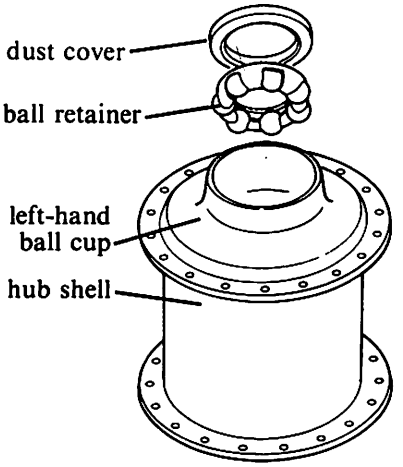
DISASSEMBLY

Driver, Hub Shell and Ball Ring

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

Remove left-hand ball cup only if necessary. Cups with wrench flats are left-threaded, all others press fit. Support hub flange on two blocks of wood and pound out press fit cup with a third block and a hammer.





Driver, Hub Shell and Ball Ring

Install left-hand ball cup in hub shell if it was removed. Non-threaded cups can be pressed into threaded hub shells. Start cup straight and pound in with a soft hammer or a hammer and a block of wood.

Install balls or ball retainer. *Orient retainer as shown.* Start dust cover straight by hand and tap home with a soft hammer.

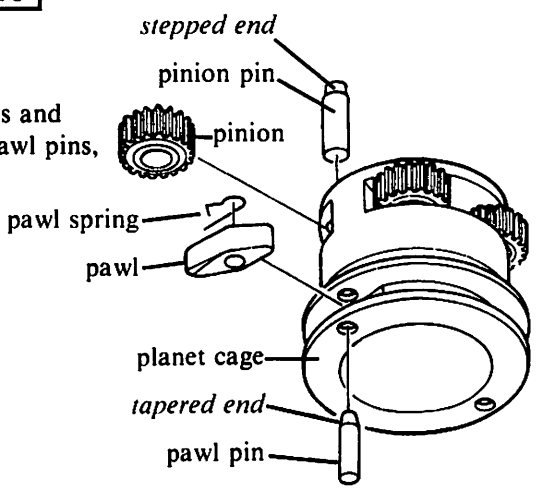
ASSEMBLY

STURMEY-ARCHER AW 3-SPEED HUB DISASSEMBLY AND ASSEMBLY (cont.) SUBASSEMBLIES

DISASSEMBLY

Planet Cage

Remove pinion pins and pinions. Remove pawl pins, pawls and springs.



Planet Cage

Slide pinion into slot and replace pinion pin *stepped end out*. Repeat for remaining pinions. Place pawl spring in position on planet cage (small) pawl, with hooked end bearing on *inside surface* of *long end* of pawl. Slide pawl and spring into slot and insert pawl pin *tapered end first*. Make sure spring is hooked around pin. Repeat for remaining pawl. Pawls must point clockwise, viewed from above. Check pawl operation before proceeding.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

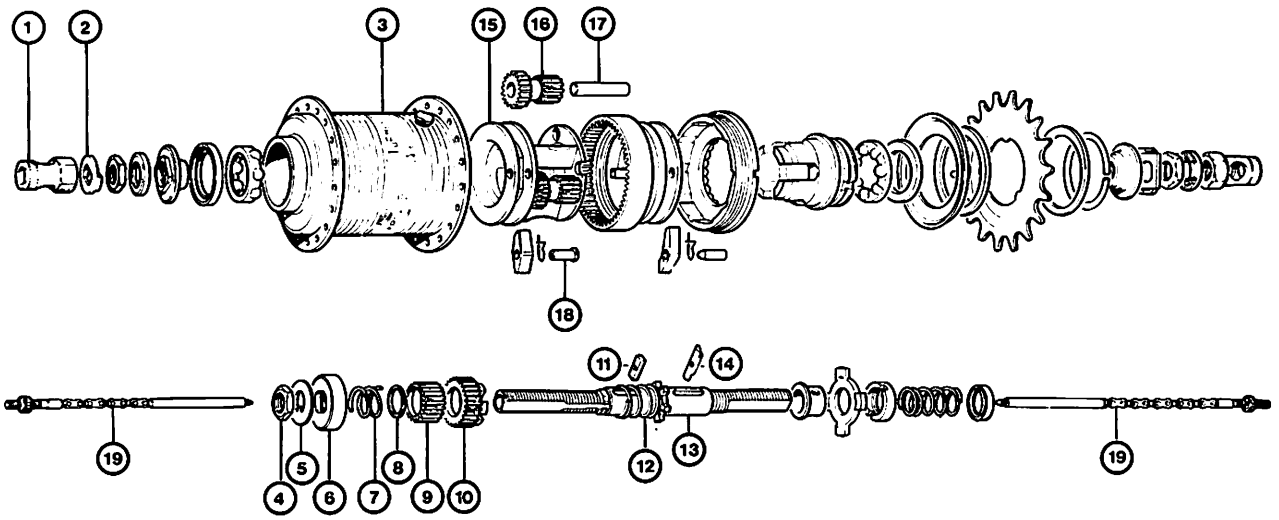
Numbers in parenthesis refer to parts chart and exploded drawing.

1. Clutch (18), gear ring internal dogs (20), and small ends of pinion pins (15) for rounded or chipped driving edges (rounding to even 1/64" (0.4 mm) at the corners of these parts may cause hub to slip out of gear)
2. Pawls (12, 21), ball ring (22) and left ball cup in hub shell (8) for worn or chipped corners
3. Sun pinion (9), planet pinions (14) and gear ring (20) for wear or chipping
4. Bearing surfaces of left ball cup (8), ball ring (22), driver (25) (inside and out), cones (5) and pinion pins (15) for wear and pitting
5. Axle key (16) and indicator chain for stripped threads
6. Clutch spring (32) for length and tension (compare with new spring)
7. Dustcaps and ball retainers for straightness
8. All threaded parts for stripped or damaged threads
9. Axle (9) for straightness

LUBRICATION

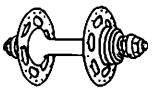
Lubricate ball bearings by filling the spaces between balls with grease. Be careful not to grease pawls. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

STURMEY-ARCHER S5.1 5-SPEED HUB



| Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.



STURMEY-ARCHER S5 and S5.1 5-SPEED and FW 4-SPEED HUBS PARTS INTERCHANGEABILITY

		S5.1 with indicator rod on left side	S5 with bell crank on left side	FW
1.	LH Axle Nut	HMN 129[1]	HMN 128	HMN 130
	RH Axle Nut	HMN 129[1]	HMN 129[1]	HMN 131
2.	Serrated Lockwasher/Axle Lockwasher	HMW 155	HMN 145[1]	HMW 145[1]
3.	Hub Shell* 36 holes	HSA 270	HSA 270	HSA 131
	40 holes		HSA 271	HSA 130
	28 holes	HSA 290		
4.	Locknut for Dog Ring	HMN 133	HMN 133	HMW 133
5.	Lockwasher for Dog Ring	HMW 149	HMW 149	HMW 149
6.	Dog Ring	HSA 138	HSA 138	HSA 138
7.	Pinion Return Spring	HSA 319		
8.	Washer for Pinion Return Spring	HMW 488		
9.	Secondary Sun Pinion	HSA 318	HSA 141	HSA 141
10.	Primary Sun Pinion	HSA 317	HSA 269	HSA 142
11.	Low Gear Axle Key	HSA 295	HSA 268	HSA 139
	Pinion Sleeve (not shown)		HSA 140	HSA 140
12.	Low Gear Spring	HSA 273	HSA 273	
	Spring Set for 4-Speed (not shown) includes HSA-143 - Low Gear Spring HSA-147 - Compensator Spring HSA-148 - Clutch Spring			HSA 183
	Collar for Compensator Spring (not shown)			HSA 146
13.	Axle $5^{13}/_{16}$" (148 mm)	HSA 320		
	$6^{1}/_{16}$" (154 mm)	HSA 321		
	$6^{5}/_{16}$" (160 mm)	HSA 322		
	$5^{3}/_{4}$" (146 mm)			HSA 144
	6" (152 mm)		HSA 274	
	$6^{1}/_{4}$" (159 mm)		HSA 145	HSA 145
14.	Axle Key	HSA 124[1]	HSA 124[1]	HSA 163[2]
15.	Planet Cage	HSA 132	HSA 132	HSA 132
16.	Planet Pinion	HSA 134	HSA 134	HSA 134
17.	Pinion Pin	HSA 135	HSA 135	HSA 135
18.	Pawl Pin for Planet Cage	HSA 133	HSA 133	HSA 133
19.	Gear Indicator RH for $5^{13}/_{16}$" Axle (148 mm)	HSA 125[1]		
	Gear Indicator RH for $6^{1}/_{16}$" Axle (154 mm) and $6^{5}/_{16}$" Axle (160 mm)	HSA 126		
	Gear Indicator LH for $5^{13}/_{16}$" Axle (148 mm) and $6^{1}/_{16}$" Axle (154 mm)	HSA 126		
	Gear Indicator LH for $6^{5}/_{16}$" Axle (160 mm)	HSA 316		
	Gear Indicator RH for $5^{3}/_{4}$" Axle		HSA 125[1]	
	Gear Indicator RH for 6", $6^{1}/_{4}$" Axle		HSA 126[1]	
	Gear Push Rod (no head, threaded) for $5^{3}/_{4}$", 6" axle		HSA 266	
	Gear Push Rod (no head, threaded) for $6^{1}/_{4}$" axle		HSA 267	
	Bellcrank (stamped steel)		HSJ 608	
	Gear Push Rod (head like a nail) for $5^{3}/_{4}$", 6" axle		HSA 287	
	Gear Push Rod (head like a nail) for $6^{1}/_{4}$" axle		HSA 288	
	Bellcrank (machined, threaded)		HSJ 679	
	Gear Indicator Rod, $5^{3}/_{4}$"			HSA 136
	Gear Indicator Rod, $6^{1}/_{4}$"			HSA 137
	Gear Indicator Coupling			HSA 149

[1] Same parts as for AW.

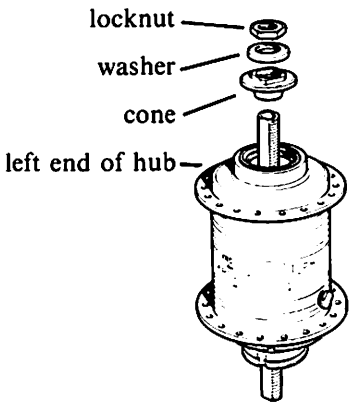
[2] HSA 163 for 4-speed is drilled through and not threaded. HSA 124 is threaded.

*The S5 cartridge will fit into any AW 3-speed hub shell. The AW cartridge will fit S5 or FW hub shells but may not work properly without changing the left ball cup. A planet cage centering flange in the AW left ball cup keeps the pawls aligned and prevents it from slipping in low gear. Not all S5 ball cups lack this flange. Compare it to an AW left ball cup.

STURMEY-ARCHER S5.1 5-SPEED HUB DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove left-hand locknut, washer and cone.



Next Step

Install cone, lockwasher and locknut. Adjust bearing.

ASSEMBLY 6

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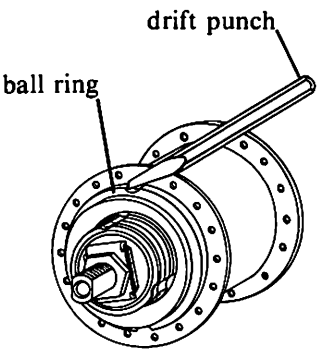
2 DISASSEMBLY

The right-hand ball ring may have a double start thread. If the ball ring is replaced in the opposite position, the wheel may need retruing. To facilitate proper reassembly, mark the ball ring at the point nearest lubricator.

Place a drift punch as shown and loosen the ball ring by rapping the punch firmly with a hammer.

Next Step



Next Step

When correctly oriented, tighten with a hammer and drift punch.

ASSEMBLY 5

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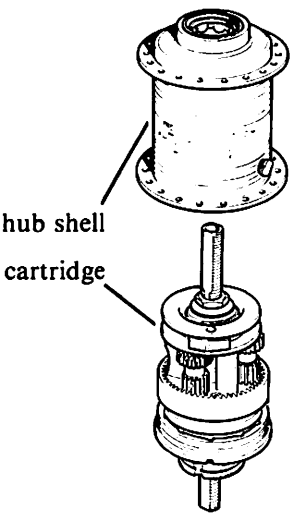
3 DISASSEMBLY

Unscrew right-hand ball ring completely and remove the cartridge from the hub shell.

Next Step
Next Page



Next Step

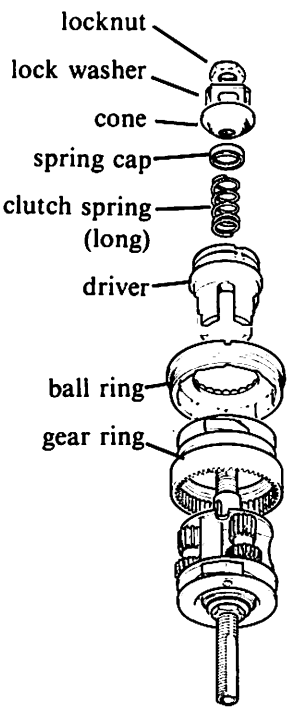
Thread cartridge finger tight into hub. If the mark made during disassembly is not next to the lubricator, remove and restart.

ASSEMBLY 4

STURMEY-ARCHER S5.1 5-SPEED HUB DISASSEMBLY AND ASSEMBLY (cont.)

4 DISASSEMBLY

Remove right-hand locknut, lockwasher and cone. Remove clutch spring, spring cap and driver.[1] Remove ball ring and gear ring.



Next Step

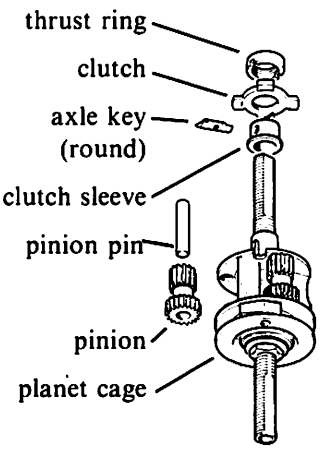
Next Step Preceding Page

Install gear ring and ball ring. Install driver, clutch spring and spring cap.[1] Install cone, lockwasher and locknut. Adjust bearing. If bearing runs rough, check spring cap.[1]

ASSEMBLY 3

5 DISASSEMBLY

Remove thrust ring.[2] Push out axle key, remove clutch sleeve and sliding clutch. Remove pinion pins and pinions. Lift off planet cage.

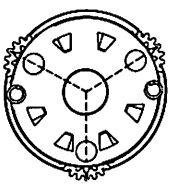


Next Step
Next Page

Next Step

Install clutch sleeve and clutch. Slide in round axle key with flats up. Install thrust ring[2] with slots seated on the axle key flats.

Pinion timing
marked teeth point outward at once



Slide planet cage over the long-slot end of axle. Note that each planet pinion has one marked tooth. Install pinions so that marked teeth point outward (see detail). *Do not let planet cage turn during pinion installation.*

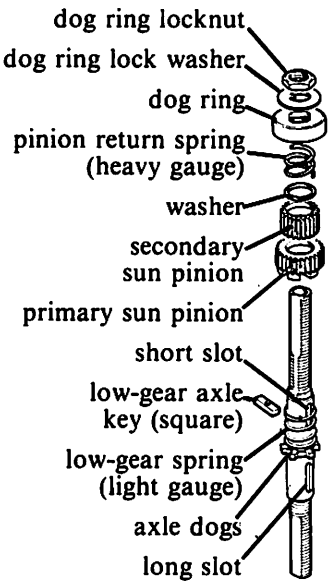
ASSEMBLY 2

[1]Old model spring caps are too large to fit through the driver. On these hubs, the spring and cap are removed *after* and installed *before* the driver. Otherwise the spring cap will be compressed between the cone and the bearing with damage to both. Upon installation the driver must be held in place against the spring until the cone is installed.

[2]If thrust ring has top and bottom openings of *equal* diameter it must have a thrust washer on top of it.

6 DISASSEMBLY

Position axle as shown. Flatten dog ring lockwasher. Remove dog ring locknut, lockwasher and dog ring. Remove pinion return spring and washer. Invert axle and tap gently to dislodge washer. With axle still inverted push the two sun pinions up until the larger one engages the axle dogs. The low-gear axle key should be visible in the bottom of its slot. Push out axle key. Remove the two sun pinions and low-gear spring.



Next Step
Preceding Page

Slide light gauge low-gear spring over short-slot end of axle. Install primary sun pinion smooth face up and secondary sun pinion smooth face down.

Push the two sun pinions along the axle so the larger engages axle dogs; invert assembly and slide in square low-gear axle key. Release the two sun pinions. If the hole in the axle key is not visible through the hollow axle, the key is not properly seated; remove and reseat.

Insert washer and pinion return spring. Install dog ring.

Install lock washer with key in axle keyway. Install *unplated* locknut *rounded side up.* Incorrect installation will cause shifting problems as this locknut has the threads relieved on one side. Push dog ring against spring until it seats over square-section part of axle and tighten locknut with a wrench. Bend up lockwasher to prevent nut from turning.

ASSEMBLY 1

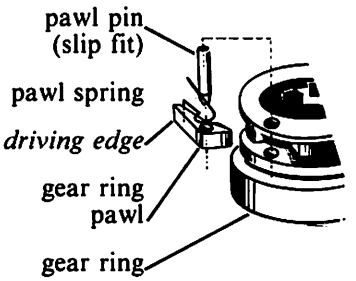
DISASSEMBLY

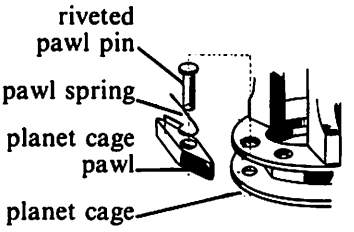
SUBASSEMBLIES

Gear Ring and Planet Cage

Pawl springs can be removed with the pawls in place, although some deformation usually results. Ease the hooked end of the spring over the side or long end of pawl to the other side. Spread the ends of spring and slide out.

If pawls are to be removed, springs are best removed at that time. Riveted pawl pins can be removed only by drilling. Hollow pawl pins can be driven out with the correct size drift punch.





Gear Ring and Planet Cage

If only pawl springs have been removed, springs may be fitted with pawls in place. Holding spring by hooked end, hook straigt end around pawl pin beside pawl. Ease hooked end over the side or long end of pawl. Straight end must come to bear on piece body and hooked end on pawl slightly behind driving edge.

If pawls were removed, fit pawl, pawl spring and pin together. *Make sure pawls are oriented as shown.*

Gear ring pawl pins are slip fit, held in place by ball ring. Solid planet cage pawl pins must be lightly riveted over. Hollow planet cage pawl pins are driven in with a soft hammer.

ASSEMBLY

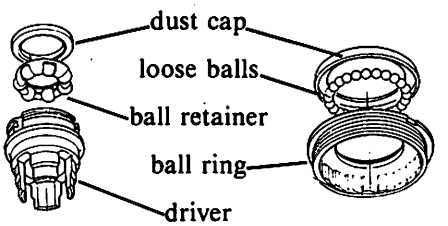
STURMEY-ARCHER S5.1 5-SPEED HUB DISASSEMBLY AND ASSEMBLY (cont.) SUBASSEMBLIES

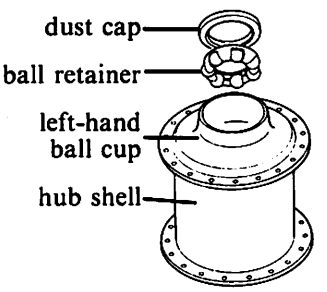
DISASSEMBLY

Driver, Hub Shell and Ball Ring

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

Remove left-hand ball cup only if necessary. Cups with wrench flats are left-threaded, all others press fit. Support hub flange on two blocks of wood and pound out press fit cup with a third block and a hammer.





Driver, Hub Shell and Ball Ring

Install left-hand ball cup in hub shell if it was removed. Non-threaded cups can be pressed into threaded hub shells. Start cup straight and pound in with a soft hammer or a hammer and a block of wood.

Install balls or ball retainer. *Orient retainer as shown.* Start dust cover straight by hand and tap home with a soft hammer.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Part numbers followed by * refer to AW parts chart, others to S5 parts chart.

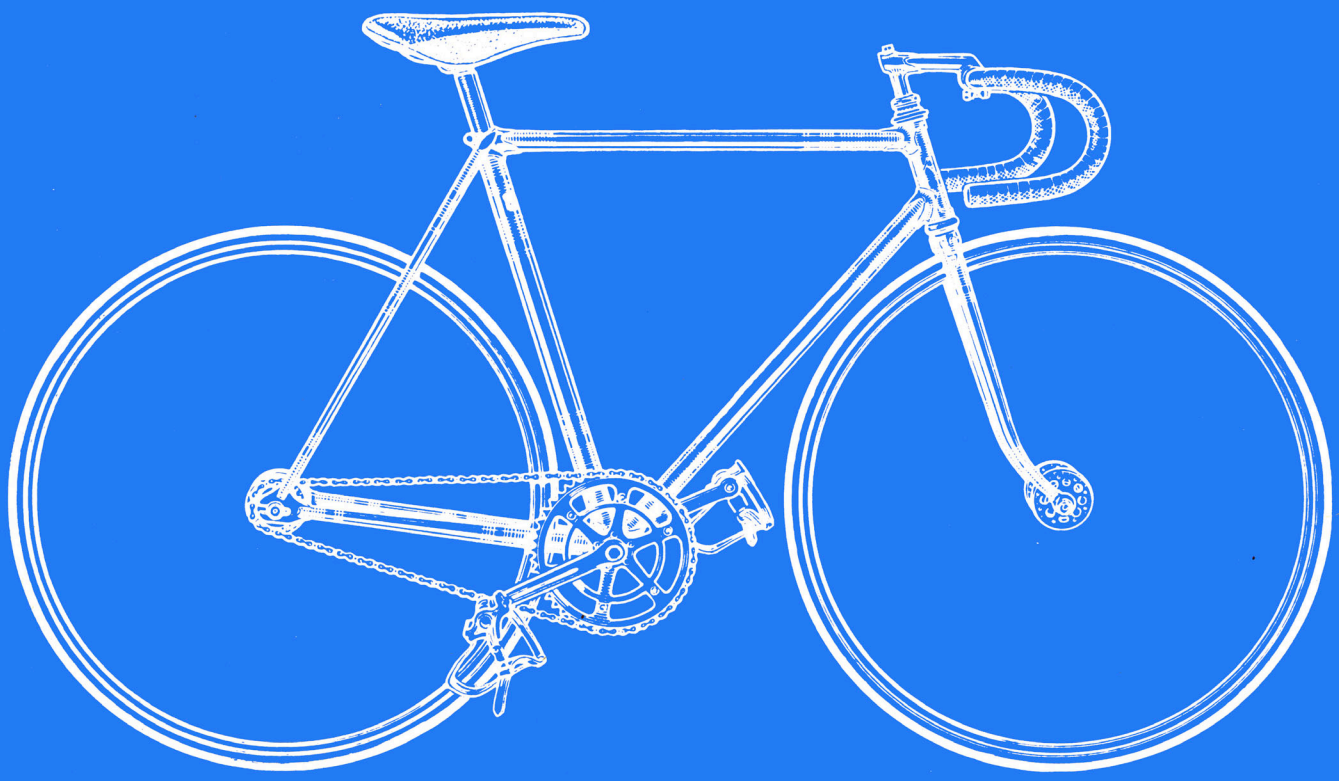
1. Clutch[1] (18*), gear ring dogs[1] (20*), planet cage (15) dogs, axle (13) dogs and primary sun pinion (10) dogs for rounding or chipping
2. Pawls (12*) (21*), ball ring (22*) and left-hand ball cup (3) for worn or chipped corners
3. Sun pinions (9) (10), planet pinions (16), dog ring (6) and gear ring (20*) for worn or chipped teeth
4. Axle keys (11) (14) and indicators (19) for stripped threads, bentl or damaged links or bent rod
5. Clutch spring (32*), pinion return spring (7) and low-gear spring (12) for length and tension (compare with new spring)
6. All threaded parts for stripped or damaged threads
7. Dustcaps and ball retainers for straightness
8. Axle (9) for straightness
9. Bearing surfaces of left ball cup (3), ball ring (22*), driver (25*), cones (5*) and pinion pins (17) for wear and pitting
10. Replace ball retainers, loose balls and pawl springs at overhaul

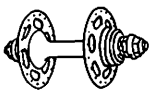
[1] Rounding to a radius of so little as 1/64" at the corners can cause hub to slip out of gear

LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Be careful not to grease pawls. Lightly oil other parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

3 Speed Coaster Brakes





THREE-SPEED COASTER BRAKES

Hub	Trouble Chart page	Parts Interchangeability Chart, Exploded Drawing page	Disassembly and Assembly Instructions page	Cleaning, Points to Check and Lubrication page	Axle Thread Size
Bendix Torpedo (see F&S Torpedo)					
F&S Torpedo					
415 (no brake)	10-5	10-24	similar to H3111		13/32" x 26 TPI
515	10-5	10-24	similar to H3111		13/32" x 26 TPI
H3111	10-5	10-24	10-26	10-28	13/32" x 26 TPI
Shimano					
3CC	10-4	10-8	10-14	10-17	3/8" x 26 TPI
3SC	10-4	10-8	10-10	10-13	3/8" x 26 TPI
333 Trimatic (similar to 3SC)					
Sturmey-Archer					
S3C	10-6	10-18	10-20	10-23	13/32" x 26 TPI
TCW-III	10-6	10-18	similar to S3C		13/32" x 26 TPI

WHEEL MOUNTING

Hubs with coaster brakes have a brake arm which prevents the left-hand cone and axle from turning. Attach the brake arm and axle nuts finger tight before cinching down either. Make sure that the brake arm clamp will not pull the brake arm out of line as this will cause severe bearing alignment problems. Tighten axle nuts first, then brake arm clamp.

TRIGGER INTERCHANGEABILITY

Triggers are not interchangeable between brands (except Bendix and F&S, which are copies). All manufacturers use the same triggers on all models, including models without coaster brakes.

HUBS

CABLE ADJUSTMENT

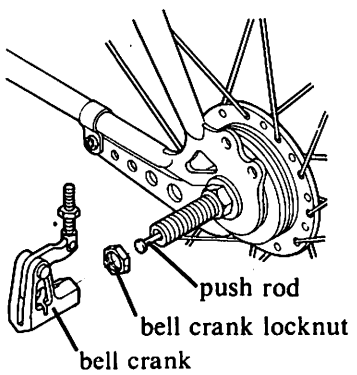
Improper cable adjustment is the most common cause of shifting problems with 3-speed coaster brakes. In order to have a hub that is in proper adjustment and *stays* that way, all cable fittings must be tight enough not to creep along the frame, the cable must be free of kinks and knots, the pulley must operate smoothly and bell crank or indicator chain must not be twisted (always back off at least ⅛ turn from finger tight when installing a new bell crank or indicator chain).

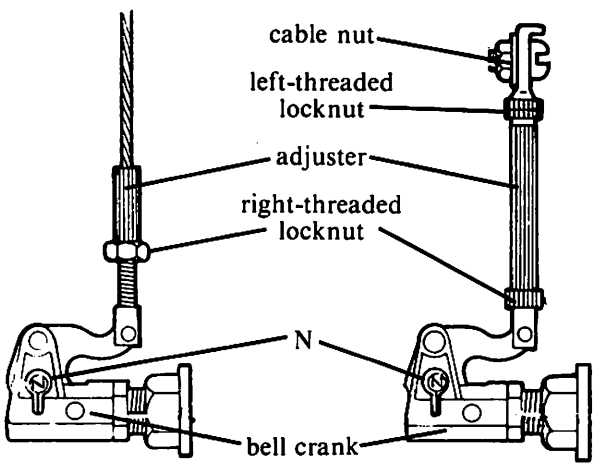
F&S Torpedo (H3111, 415, 515)

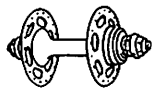
Shift into 3rd gear and turn pedals at least one full turn. Slacken cable, then tighten until indicator chain just begins to move at the point where it emerges from axle nut. Check adjustment by shifting into 1st gear (turn pedals) and pulling on cable by hand: indicator chain should not move.

Shimano (3SC and 3CC)

Loosen bell crank locknut and make sure that bell crank is backed off ⅛ to ⅝ of a turn from finger tight (set screw in the side of the bell crank against the end of axle). Adjust cable so that the circled N on the bell crank paddle is centered in the hole through which it is visible when the trigger is in the *N* position.

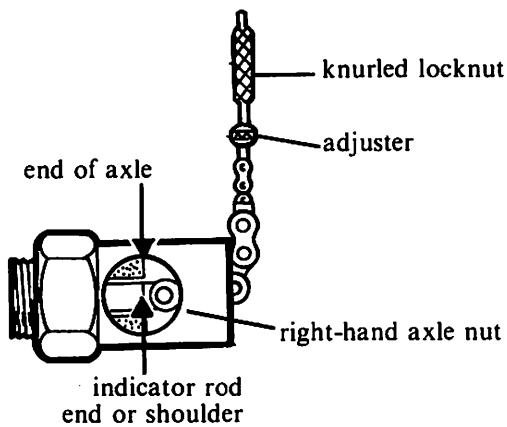




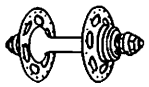


Sturmey-Archer (S3C)

Make sure that indicator rod is backed off from ⅛ to ⅝ of a turn from finger tight. Adjust cable so that the end of the indicator rod is just even with the end of the axle with the shifter in the *N* position.[1] This method may not work with a non-standard indicator chain or axle. If it cannot be used, adjust the cable so that the "dead spot" (pedals freewheeling forward) falls exactly half way between *N* and *H* shift trigger positions. This is best done by moving the pedals quickly back and forth with one hand while slowly pushing the trigger from *H* toward *N*. Count indicator chain links as they come out of the axle before the *beginning* of the dead spot; continue moving the pedals and advancing trigger and count the number of links that emerge between the *end* of the dead spot and the click as the trigger goes to *N*. If these two counts are not the same, adjust the cable and try again. In no case should either gear be closer than ½ *link* to the dead spot. Tighten knurled locknut against adjuster.



[1] If the end of the axle is not visible in the axle nut window, indicator chain will bottom at last link in low gear. Install a spacer under axle nut.

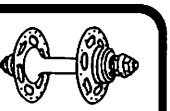


HUBS

SHIMANO 3SC and 3CC 3-SPEED COASTER BRAKES TROUBLE CHART

Symptom	Possible Causes[1] Resulting from wear, improper lubrication or abuse	Resulting from improper assembly or installation
Slips in 1st and 2nd gear	Planet carrier (25) pawls (D) faulty, pawl springs weak or broken	Planet carrier (25) pawls (D) or pawl springs (D) improperly installed
		Stop spring (26) incorrectly installed
Jumps from 1st to 2nd	Cable too loose	
Jumps from 2nd to 1st	Sliding clutch (39) driving edge rounded	
	Planet carrier (25) internal dogs worn	
2nd instead of 1st	Return spring (20) weak	Return spring (20) missing
Jumps from 3rd to 2nd	Cable too tight	
2nd instead of 3rd		Axle key (38) reversed or crooked in axle slot
Slips in 1st gear	Ring gear (44) pawls (E) or pawl springs (E) faulty	Ring gear (44) pawls or pawl springs improperly installed
Brake grabs or jerks	Brake arm (11) (12) loose at frame	
	Wrong lubricant or lack of lubricant	
Stiff running or noisy	Brake arm (11) (12) forcing brake cone (11) (14) out of line	Stop nut (33) adjusted for insufficient brake shoe play (3SC)
	One pawl of a pair faulty	Thrust washer (32) or clutch washer (40) missing
	Axle bent	Slide spring (23) reversed
	Dropouts not parallel	Brake shoes (16) misaligned or reversed
	Improper or no lubrication	One pawl of a pair improperly installed
	Loose or broken parts inside hub	Ball retainer reversed
	Chain too tight	
	Cones too tight	
	Gear teeth chipped or worn	
	Ball retainer damaged or broken	
No brake Weak brake Too much pedal travel	Slide spring (23) weak or broken	Stop nut (33) adjusted for excessive brake shoe play (3SC)
	Hub shell or brake shoes (16) (17) glazed or worn	
	Wrong lubricant	
	Brake shoe (16) or planet carrier (25) tapered surfaces worn or burred	
Brake slips in 1st and 2nd gear	Ring gear (43) lead (49) or cam (50) teeth worn	

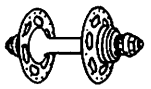
[1] Numbers in parenthesis refer to parts chart and exploded drawing.



F & S 3-SPEED HUBS & 3-SPEED COASTER BRAKES TROUBLE CHART

Symptom	Possible Causes[1] Resulting from wear, improper lubrication or abuse	Resulting from improper assembly or installation
Slips in 1st gear, Slips in 2nd gear, Slips in 3rd gear	Brake cone (13) pawls faulty	Brake cone (13) pawls improperly installed
	Clutch gear (33) teeth broken	
	Improper lubrication—gummed or dirty	
Jumps from 2nd to 1st, Jumps from 3rd to 2nd	Gear ring (29) pawls faulty	Gear ring (29) pawls improperly installed
	Cable too tight	
Jumps from 1st to 2nd, Jumps from 2nd to 3rd	Cable too loose	
	Axle key (54) threads stripped	
Pedals driven forward while coasting	Chain too tight	
	Bearings too tight	
Stiff running, noisy	No lubrication or wrong lubrication	Axle circlip (17) missing
		Ball retainer reversed
	Ball retainer damaged or broken	Friction spring (14) reversed
	Brake lever (6) forcing cone out of line	
Jammed	Loose or broken parts inside hub	
	Broken gear teeth	
Sluggish shifting	Pull chain (55) damaged	
	Cable kinked, damaged, unlubricated	
Too much play in axle	Bearings loose or damaged	
No brake	Friction spring (14) weak or worn	Friction spring (14) missing
Weak brake	Wrong lubricant	
	Brake parts glazed or worn	
Brake too strong or jerky	Brake lever (6) loose at chainstay	
	Brake shell (11) unlubricated	
	Axle (39) loose in dropouts	
Brake does not release	Unlubricated thrust surface between axle (39) and planet carrier (19)	
	Planet carrier (19) and brake cone (13) threads worn or chipped	

[1] Parts numbers in parenthesis refer to parts chart and exploded drawing.



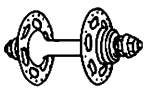
HUBS

STURMEY-ARCHER S3C and TCW-III 3-SPEED COASTER BRAKES TROUBLE CHART

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
2nd gear instead of 1st		Planet cage (9) pawl ring pawls installed in gear ring (20*)
		Ratchet ring (17) improperly installed: dogs *beside* gear ring (14) tabs rather than *engaging slots* in tab
Jumps from 1st to 2nd	Clutch spring (32*) bent or too long	No washer (4*) under right-hand axle nut (31*): indicator chain bottoms out at last link
Slips in 2nd	Cable too loose	Indicator (27) not fully screwed in
	Indicator (27) threads stripped	
	Gear ring (14) dogs worn	
	Clutch (26) worn	
	Pinion pin (12) ends worn	
2nd gear instead of 3rd Jumps from 3rd to 2nd	Gear ring pawl ring (15) pawls faulty or worn, pawl springs weak or broken	Gear ring pawl ring (15) pawls or springs improperly installed
Slips in 3rd	Cable too tight	
	Dirt between axle (24) and clutch (26)	
Sluggish shifting	Weak or bent clutch spring (32*)	
Slips in 1st	Right-hand cone (5*) too loose	
	Cable sticks; indicator chain twisted	
(cont.)	Planet cage pawl ring (9) pawls sticking or pawl springs weak	Planet cage pawl ring (9) pawls or springs improperly installed

Next Page

[1] Parts numbers followed by * refer to AW parts chart p. 9-17, others to S3C/TCW-III parts chart p. 10-18.



STURMEY-ARCHER S3C and TCW-III 3-SPEED COASTER BRAKES TROUBLE CHART (cont.)

Symptom	Possible Causes[1]: Resulting from wear, improper lubrication or abuse	Possible Causes[1]: Resulting from improper assembly or installation
Stiff running noisy	Chain too tight	Spring cap (33*) pinched between right-hand cone and driver (19)
	One pawl of a pair sticking	Too many balls in ball ring (18)
	Chainstay ends not parallel	AW ball ring (18) installed in S3C
	Loose or broken parts inside hub	Ball retainer reversed
	Dust caps distorted	One pawl of a pair improperly installed
	Ball retainer damaged or broken	
Brake will not release	Corroded parts; improper or no lubrication	Wider TCW brake band (6) in S3C
	Axle (24) bent	Brake actuating spring (7) reversed
	Left-hand cone (3), brake band (6) or thrust plate (8) tapered surfaces rough or burred	
	Brake arm (1) forcing left-hand cone (3) out of line	
	Cones too tight	
Too much back-pedal travel		Wide S3C ball ring (18) on TCW III
Weak brake	Improperly lubrication—too slippery	
	Brake band (6) or hub shell (5) worn or glazed	
	Thrust plate (8) or planet cage (13) threads chipped	
No brake (pedals slip back)	Brake actuating spring (7) worn or damaged	Brake actuating spring (7) missing
Intermittent brake	Driver (19) pawls or pawl springs faulty, broken (S3C)	Driver (19) pawls missing, backwards; pawl springs improperly installed
	Cable misadjusted (TCW III)	

[1] Parts numbers followed by * refer to AW parts chart, others to S3C/TCW-III parts chart.

HUBS

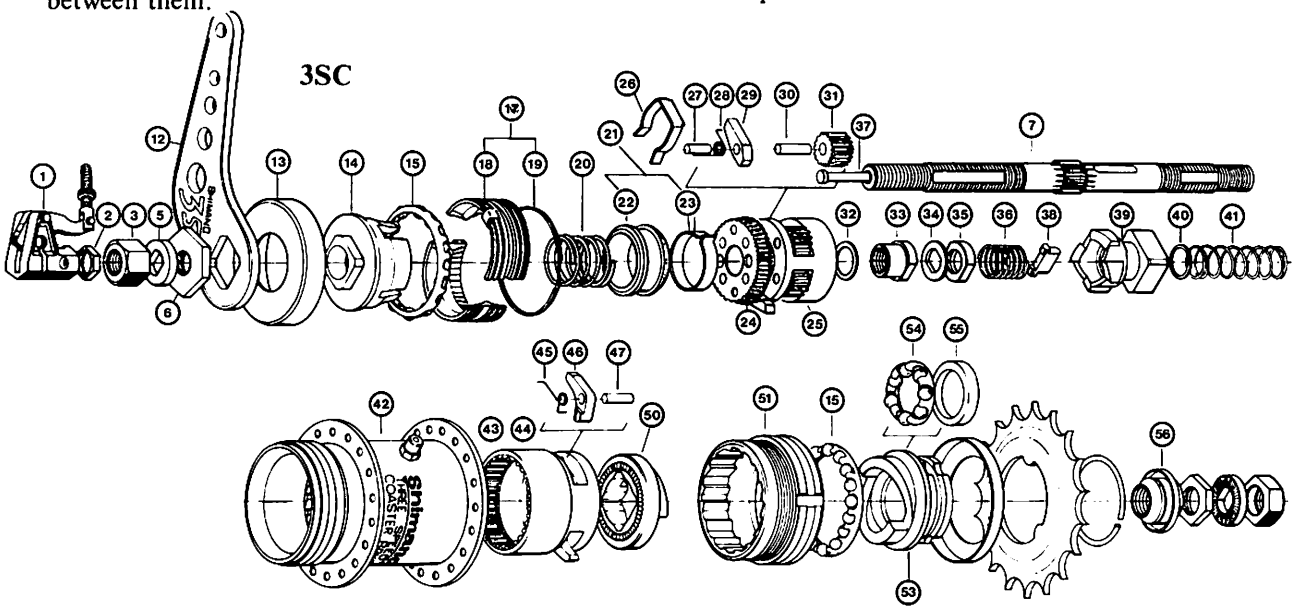
SHIMANO 3 SPEED COASTER BRAKE

Vertical line between numbers indicates parts are not interchangeable.

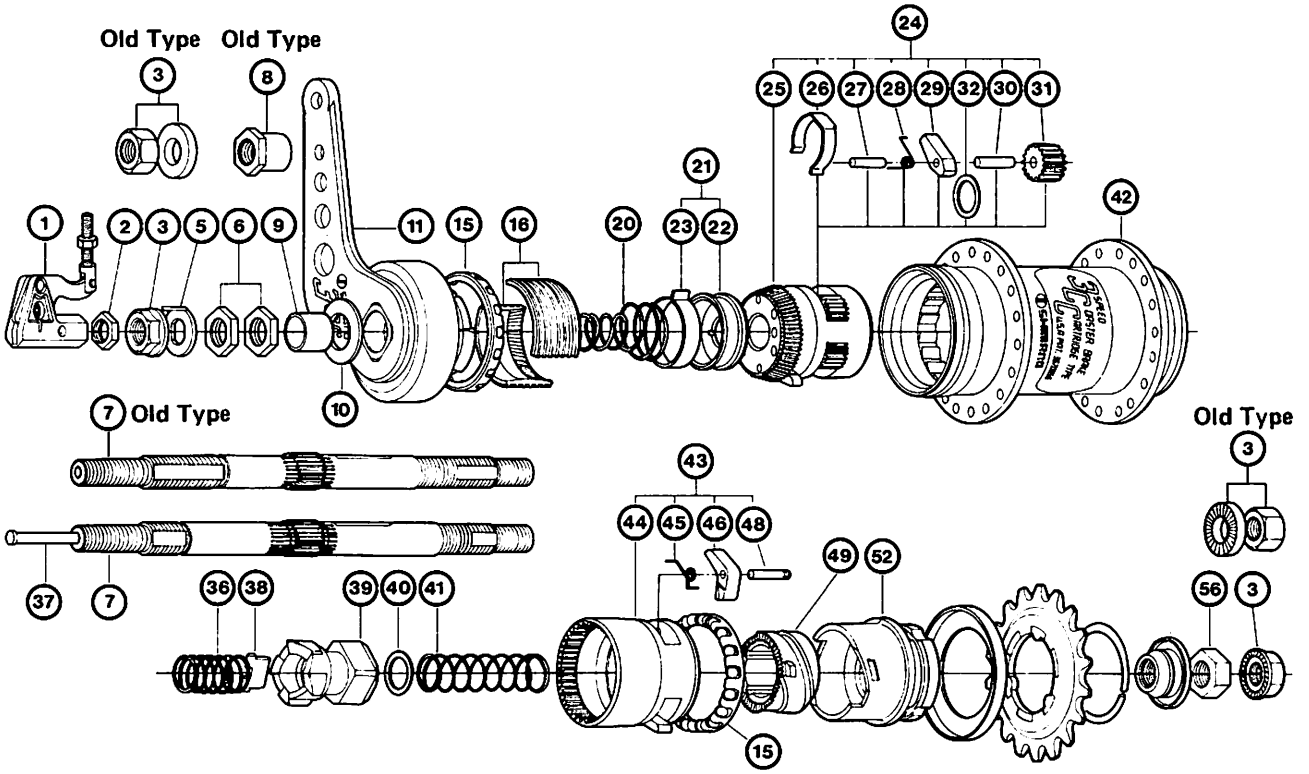
Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

Parts not numbered are interchangeable with Shimano 3-speed.

Additional parts which are interchangeable with Shimano 3-speed are marked with an asterisk in the parts table.



3CC CARTRIDGE TYPE



SHIMANO 3-SPEED COASTER BRAKE PARTS INTERCHANGEABILITY

		New Type 3CC TC-200	Old Type 3CC TC-100	3SC
1.	Bell Crank Complete	321 9029-1	333 9001-1	333 9001-1
2.	Bell Crank Locknut	321 8300*	321 8300*	321 8300*
3.	Axle Nut	220 1501-1	200 0300	333 4100
4.	Lock Washer			333 4200
5.	Non Turn Washer	321 6400	321 6400	
6.	Left-Hand Locknut	321 3900	321 3900	333 0301
7.	Axle 168 mm (6⅝")	334 1500-1[2]	334 1500[2]	333 3800
8.	Stop Nut		334 0400[2]	
9.	Sleeve	334 0400-1[2]		
10.	Brake Arm Washer	334 1600	334 1600	
11.	Brake Arm Assembly	334 9007	334 9007	
12.	Brake Arm			333 0500-1
13.	Dust Cap L			333 1100-1
14.	Brake Cone			333 1200-1
15.	Ball Retainer B	321 9023*	321 9023*	321 9023*
16.	Brake Shoe Set	334 9008	334 9008	
17.	Brake Shoe and Spring			333 9031[1]
18.	Brake Shoe			333 1300
19.	Brake Shoe Spring			333 1400
20.	Return Spring	334 0800	334 0800	333 1900
21.	Spring Guide and Slide Spring	333 9032	333 9032	333 9032
22.	Spring Guide	333 2100	333 2100	333 2100
23.	Slide Spring	333 2000	333 2000	333 2000
24.	Carrier Assembly	334 9009	334 9009	
25.	Carrier	333 2200	333 2200	333 2200
26.	Stop Spring	333 4800	333 4800	333 4800
27.	Pawl Pin D	333 2600	333 2600	333 2600
28.	Pawl Spring D	333 2700	333 2700	333 2700
29.	Pawl D	333 2500	333 2500	333 2500
30.	Pinion Pin	333 2300-1	333 2300-1	333 2300-1
31.	Planet Pinion	321 5500*	321 5500*	321 5500*
32.	Thrust Washer	333 2400	333 2400	333 2400
33.	Stop Nut			333 0400-1
34.	Non Turn Washer			333 3900
35.	Lock Nut B			333 4000-1
36.	Clutch Spring B	332 3400	332 3400	333 3200
37.	Push Rod	321 7300-1	321 7300	321 7300
38.	Axle Key	333 3300	333 3300	333 3300
39.	Sliding Clutch	334 1200-1	334 1200	333 3100
40.	Clutch Washer	333 3400	333 3400	333 3400
41.	Clutch Spring A	333 3500	333 3500	333 3500
42.	Hub Shell 28 holes	334 9003-1	334 9003	333 9007
	36 holes	334 9005-1	334 9005	333 9014
43.	Ring Gear Assembly	334 9010	334 9010	
44.	Ring Gear	334 1100	334 1100	333 2800
45.	Pawl Spring E	333 3000	333 3000	333 3000
46.	Pawl E	333 2900	333 2900	333 2900
47.	Pawl Pin D			333 2600
48.	Pawl Pin E	333 4600	333 4600	
49.	Lead	334 1300	334 1300	
50.	Cam			333 3600
51.	Right-Hand Ball Cup			333 1800
52.	Driver with Ball Retainer, Dust Cap	334 9015	334 9015	
53.	Driver			333 3700
54.	Ball Retainer A			321 9022
55.	Dust Cap A			321 2700
56.	Right-Hand Locknut	321 4000	321 4000	

*Interchangeable with Shimano 3-speed.

[1] Old part number 33 9019.

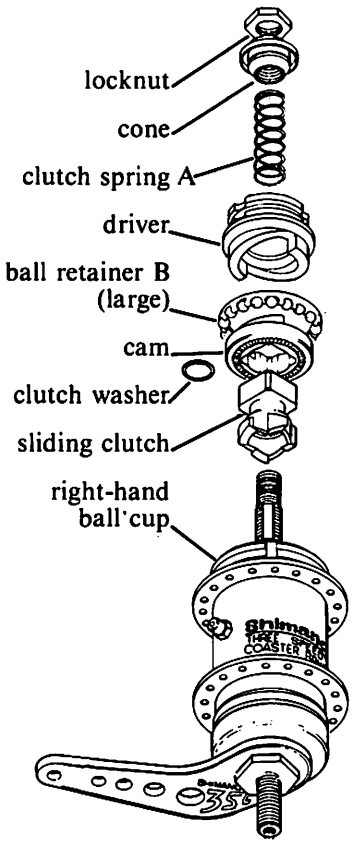
[2] New Style Axle (334-1500-1) combined with Sleeve (334-0400-1) interchange with Old Style Axle (334-1500) and Stop Nut (334-0400). Individually these parts are not interchangeable

SHIMANO 3SC 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove right-hand locknut and cone. Lift off driver and clutch spring A. Remove sliding clutch, cam and large ball retainer (B). Remove clutch washer from inside clutch.

Slip Shimano ball cup tool (not shown) over axle to engage right-hand ball cup. Invert assembly, hold tool in vise and turn wheel counter-clockwise to loosen ball cup.



Next Step

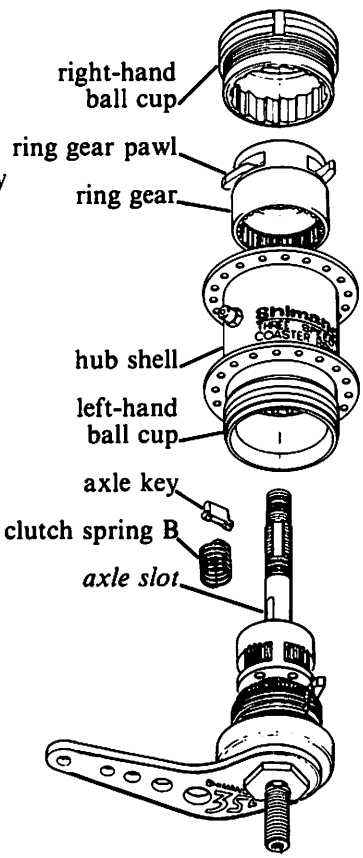
Install sliding clutch, square end up. Install cam *flat serrated side down*. Install clutch washer clutch spring and driver. Install ball retainer (B) *flat side up*. Install right-hand cone and locknut. Adjust bearing.

ASSEMBLY 4

Next Step

2 DISASSEMBLY

Remove tool, lift hub slightly and unscrew ball cup. Remove hub shell and ring gear assembly. Remove axle key and light gauge spring (clutch spring B) from axle.



Next Step
Next Page

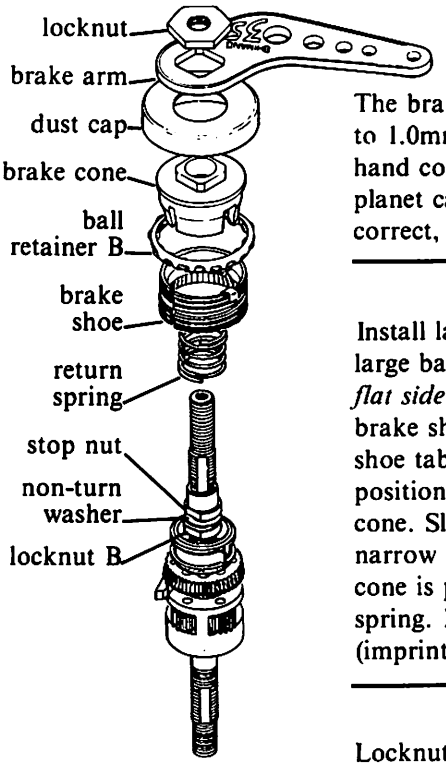
Invert assembly. Install light gauge clutch spring (B). Install axle key *notch down* in axle slot. Slip hub shell over assembly with left-hand ball cup seating against balls in ball retainer. Rotate ring gear pawls into operating position (full clockwise, viewed from above), press in and slip ring gear over axle into hub shell. Thread in right-hand ball cup. Tighten with ball-cup tool.

ASSEMBLY 3

SHIMANO 3SC
3-SPEED COASTER BRAKE
DISASSEMBLY AND ASSEMBLY (cont.)

(3) DISASSEMBLY

Remove left-hand locknut. Lift off brake arm, dust cap, brake cone, large ball retainer (B) and brake shoe. Remove return spring. Loosen stop nut. If merely adjusting brake shoe clearance, go to assembly step 2.



Next Step Preceding Page

The brake shoe should have from 0.5mm to 1.0mm vertical play between the left-hand cone and the serrated end of the planet carrier. If adjustment is not correct, go to disassembly, step 3.

Install large diameter return spring. Slip large ball retainer over left hand cone *flat side toward dust cap*. Assemble brake shoe and brake cone with brake shoe tabs engaging slots in cone. Note position of the narrow slot in brake cone. Slip assembly over axle so that narrow slot engages slide spring as brake cone is pushed down against return spring. Install dust cap, brake arm (imprinted side up) and large locknut.

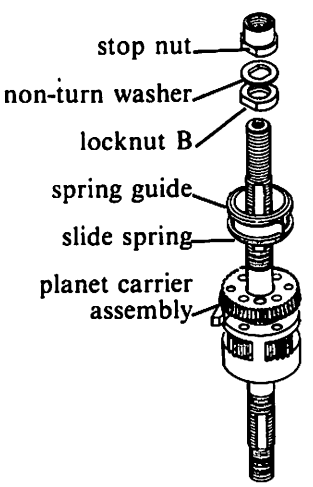
Locknut (B) determines brake shoe play; threading it down reduces play, threading it up increases play. Lock locknut (B) in place with non-turn washer and stop nut as shown.

ASSEMBLY 2

Next Step

(4) DISASSEMBLY

Remove stop nut, non-turn washer and locknut (B). Lift off spring guide and planet carrier. Remove slide spring from spring guide only if it is to be replace.



Next Step

Install spring guide with dogs down. Make sure hooked end of slide spring is *clockwise from spring gap*. Incorrect installation will cause excessive drag and wear. Spring guide dogs engage holes in planet carrier. Thread locknut (B) finger tight against axle shoulder, then back off about one full turn.

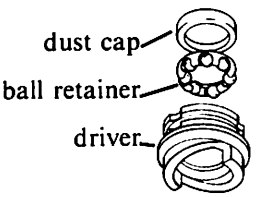
Fix axle in vise, hollow end up. Slip planet carrier assembly over axle with planet pinions engaging sun pinion.

ASSEMBLY 1

SHIMANO 3SC
3-SPEED COASTER BRAKE
DISASSEMBLY AND ASSEMBLY (cont.)
SUBASSEMBLIES

DISASSEMBLY

Driver
Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.

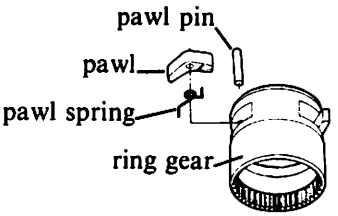


Driver
Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

ASSEMBLY

DISASSEMBLY

Ring Gear
Push out pawl pins (E), catch pawls (E) and pawl springs (E).

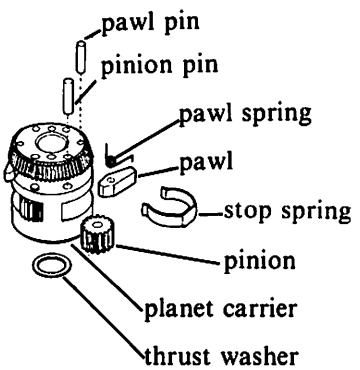


Ring Gear
Position ring gear with *gear teeth down.* When installed, Pawl (E) has *long end out* and *recessed side down.* Pawl spring (E) lies in pawl recess with *long* hooked leg through hole in gear ring and *short* hooked leg bearing against the *outside surface* of the *short end* of pawl (*long* leg has *short* hooked segment and vice versa). Install pawl spring, pawl and pawl pin. *Be sure pin passes through spring coil.* Check pawl operation. Repeat for other pawl.

ASSEMBLY

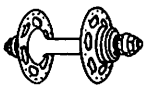
DISASSEMBLY

Planet Carrier
Tap out pawl pins (D) a few millimeters. Pull pins out, catch pawls (D) and pawl springs (D). Remove stop spring form carrier body groove. Tap or push out pinion pins. Remove pinions. Extract thrust washer.



Planet Carrier
Stick thrust washer in place. Position pinion, insert pinion pin. Repeat for remaining pinions. Pins protrude about 1mm above the central planet carrier flange. Install stop ring with wide section between the protruding ends of two pinion pins *that do not have a pawl pin hole between them.* Position planet carrier with serrated cone up. When installed, hooked end of pawl spring (D) bears against *inside* surface of the *long end* of pawl (D). Straight end of pawl spring bears against stop spring. Install pawls with *driving edge pointing counter-clockwise.* Insert pawl pin through pawl spring and pawl. Pawl pin does not protrude above carrier body. Check pawl operation before proceeding.

ASSEMBLY



SHIMANO 3SC
3-SPEED COASTER BRAKE
DISASSEMBLY AND ASSEMBLY (cont.)

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Numbers in parenthesis refer to parts chart and exploded drawing.

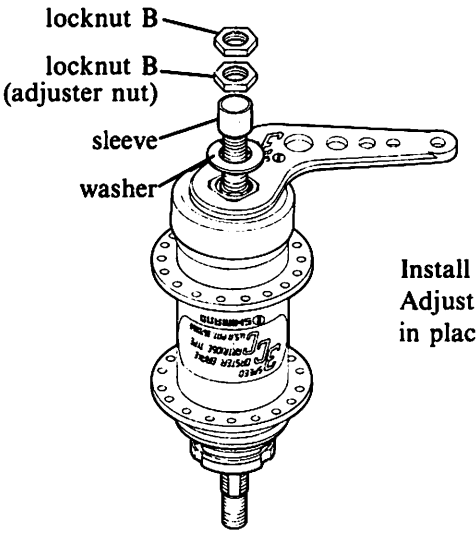
1. Pawls (29, 46), ratchets in hub shell (42) and right-hand ball cup (51) for chipped or rounded edges
2. Gear teeth on axle (7), planet pinions (31), and ring gear (43) for wear and chipping
3. Sliding clutch (39), and inside of planet carrier (24) for rounded or chipped driving edges
4. Return spring (20), slide spring (23), stop spring (26) and clutch springs (36, 41) for shape and tension; replace pawl springs (28, 45) at overhaul
5. Right-hand cone, driver (53), brake cone (14) and hub shell (42) bearing races for wear and pitting
6. Dustcaps, ball retainers (15, 54) and axle (7) for straightness
7. All threaded parts for damaged or stripped threads
8. Brake shoes (18) and hub shell (42) for wear or glazing
9. Teeth or serrations of cam (50), ring gear (44), planet carrier (24) and brake shoes (18) for wear or burring
10. Threads of cam (50) and driver (53) for wear or roughness

LUBRICATION

Lubricate ball retainers by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Be careful not to grease pawl springs. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

HUBS

SHIMANO 3CC CARTRIDGE TYPE 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY



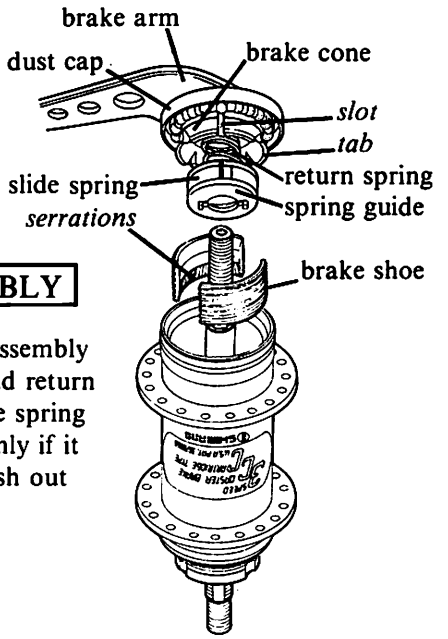
1 DISASSEMBLY

Remove left-hand B locknuts, washer and sleeve.

Next Step

Install washer, sleeve and B locknuts. Adjust bearing, locking first locknut in place with the second.

ASSEMBLY 4



2 DISASSEMBLY

Lift off brake arm assembly with spring guide and return spring. Remove slide spring from spring guide only if it is to be replaced. Fish out brake shoes.

Next Step
Next Page

Next Step

Position brake shoes *internal serrations down* and stick into hub shell. Replace spring guide slide spring if it was removed. Viewed as shown, *hooked end of slide spring must be counter-clockwise from gap.* Incorrect installation will cause excessive drag and wear.

Assemble brake arm, spring guide and return spring into a single unit by inserting return spring with a clockwise twisting motion. *Rotate spring guide until hooked end of slide spring is aligned with brake cone slot.* Note position of brake cone tabs, and slip spring-guide/brake-cone assembly over axle with brake cone tabs engaging gaps between brake shoes. Rotate slightly until properly seated.

ASSEMBLY 3

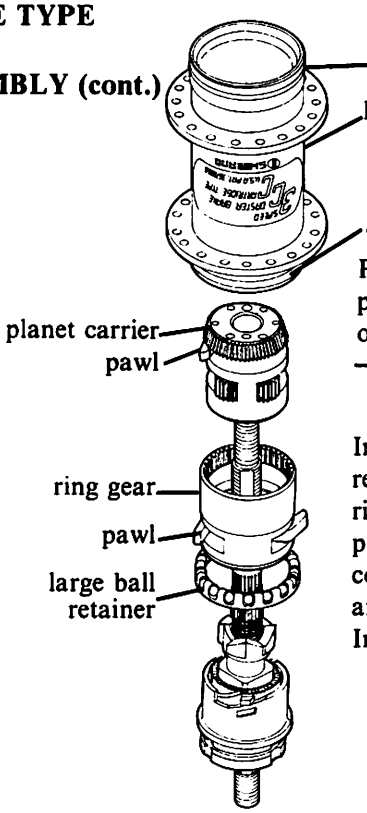
SHIMANO 3CC CARTRIDGE TYPE 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Lift off hub shell.

Remove planet carrier assembly. Hold ring gear pawls full counter-clockwise and lift carrier off over sliding clutch. Remove large ball retainer.

Next Step



Next Step Preceding Page

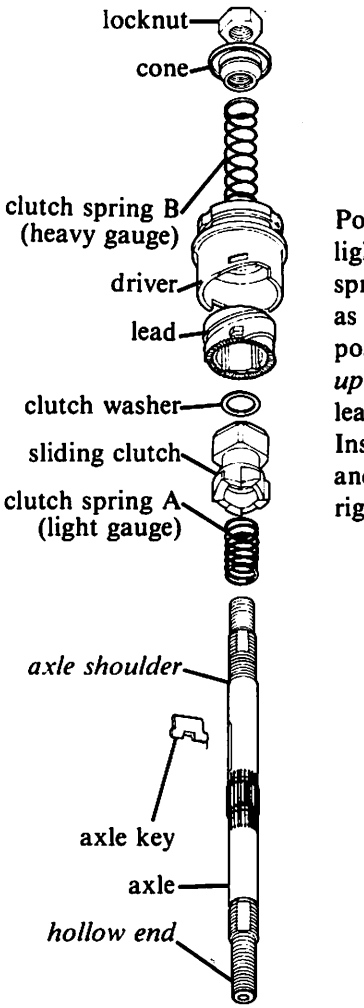
Position hub shell *long end up,* push in planet carrier pawls and slip hub shell over assembly.

Invert assembly. Install large ball retainer *flat side toward driver.* Position ring gear assembly *gear teeth up,* rotate pawls into operating position (full counter-clockwise, viewed from above) and slip ring gear over sliding clutch. Insert planet carrier into ring gear.

ASSEMBLY 2

4 DISASSEMBLY

Invert assembly, remove right-hand locknut, cone and heavy gauge clutch spring (B). Lift off driver and lead. Remove sliding clutch; extract clutch washer from inside clutch. Remove axle key and light gauge clutch spring (A).



Next Step

Position axle *hollow end down.* Install light gauge clutch spring (A). Compress spring and insert axle key *notch down* as shown. Release spring to hold key in position. Install sliding clutch *square end up.* Slip clutch washer into clutch. Install lead teeth down. Screw driver onto lead. Install clutch spring (B). Thread on cone and tighten against axle shoulder. Install right-hand locknut.

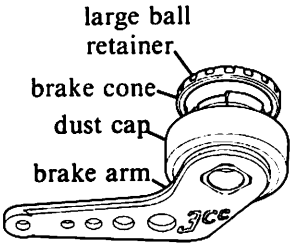
ASSEMBLY 1

SHIMANO 3CC CARTRIDGE TYPE 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

SUBASSEMBLIES

DISASSEMBLY

Pop large ball retainer over brake cone tabs. Brake cone, brake arm and dust cap are press fit together and should not be forced apart.

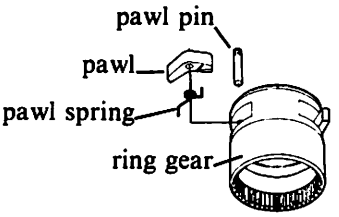


Pop large ball retainer over brake cone tabs *flat side toward dust cap.*

ASSEMBLY

DISASSEMBLY

Ring Gear
Push out pawl pins (E), catch pawls (E) and pawl springs (E).

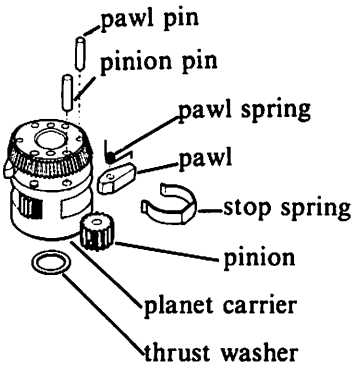


Ring Gear
Position ring gear with *gear teeth down.* When installed, Pawl (E) has *long end out* and *recessed side down.* Pawl spring (E) lies in pawl recess with *long* hooked leg through hole in gear ring and *short* hooked leg bearing against the *outside surface* of the *short end* of pawl (*long* leg has *short* hooked segment and vice versa). Install pawl spring, pawl and pawl pin. *Be sure pin passes through spring coil.* Check pawl operation. Repeat for other pawl.

ASSEMBLY

DISASSEMBLY

Planet Carrier
Tap out pawl pins (D) a few millimeters. Pull pins out, catch pawls (D) and pawl springs (D). Remove stop spring form carrier body groove. Tap or push out pinion pins. Remove pinions. Extract thrust washer.



Planet Carrier
Stick thrust washer in place. Position pinion, insert pinion pin. Repeat for remaining pinions. Pins protrude about 1mm above the central planet carrier flange. Install stop ring with wide section between the protruding ends of two pinion pins *that do not have a pawl pin hole between them.* Position planet carrier with serrated cone up. When installed, hooked end of pawl spring (D) bears against *inside* surface of the *long end* of pawl (D). Straight end of pawl spring bears against stop spring. Install pawls with *driving edge pointing counter-clockwise.* Insert pawl pin through pawl spring and pawl. Pawl pin does not protrude above carrier body. Check pawl operation before proceeding.

ASSEMBLY

SHIMANO 3CC CARTRIDGE TYPE 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

1. Pawls (29, 46), ratchets in hub shell (42) for chipped or rounded edges
2. Gear teeth on axle (7), planet pinions (31), and ring gear (42) for wear and chipping
3. Sliding clutch (39), and inside of planet carrier (24) for rounded or chipped driving edges
4. Return spring (20), slide spring (23), stop spring (26) and clutch springs (36, 41) for shape and tension; replace pawl springs (28, 45) at overhaul
5. Right-hand cone, driver (52), brake cone (11) and hub shell (42) bearing races for wear and pitting
6. Dustcaps, ball retainers (15, 52) and axle (7) for straightness
7. All threaded parts for damaged or stripped threads
8. Brake shoes (16) and hub shell (42) for wear or glazing
9. Teeth or serrations of lead (49), ring gear (44), planet carrier (24) and brake shoes (16) for wear or burring
10. Threads of lead (49) and driver (52) for wear or roughness

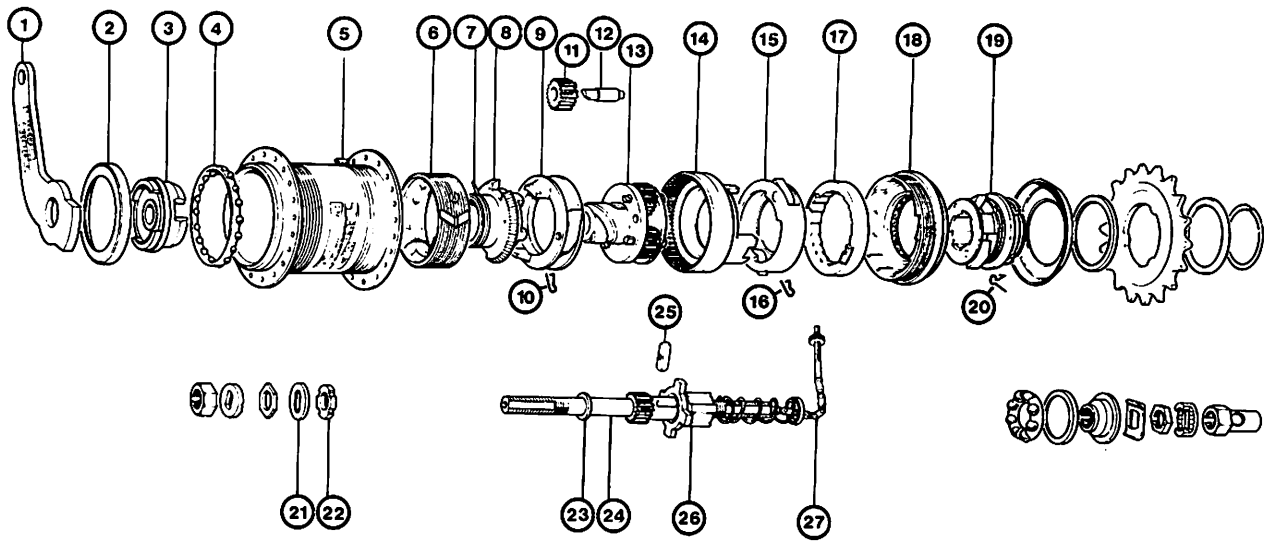
LUBRICATION

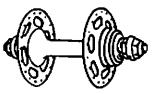
Lubricate ball retainers by filling the spaces between balls with grease. Lubricate hub shell and brake shoes liberally with a high-temperature grease. Be careful not to grease pawl springs. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

HUBS

STURMEY-ARCHER 3-SPEED COASTER BRAKE

S3C





STURMEY-ARCHER 3-SPEED COASTER BRAKES PARTS INTERCHANGEABILITY

| Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

Parts not listed are the same as AW.

		Tricoaster S3C Changes	Tricoaster S3C	TCW Mark III
	Brake Arm / LH Cone / Dust Cap Assembly		HSH 449	HSH 403
1.	Brake Arm	HSH 450[1]	HSH 446	HSH 402
2.	LH Dust Cap		HSH 404	HSH 404
3.	LH Cone		HSH 447	HSH 405
4.	Ball Cage (18-3/16" balls)		HSA 164	HSA 164
	Lubricator (old style)		HSA 106	HSA 106
5.	Hub Shell 28 hole		HSA 232	
	36 hole		HSA 233	HSA 166
	40 hole		HSA 323	HSA 165
6.	Brake Band		HSH 448	HSH 406
7.	Brake Actuating Spring		HSH 407	HSH 407
8.	Thrust Plate		HSH 408	HSH 408
9.	Planet Cage Pawl Ring Assembly		HSA 168	HSA 168
10.	Pawl Spring		HSA 120[2]	HSA 120[2]
11.	Planet Pinion		HSA 292	HSA 115
12.	Pinion Pin		HSA 293	HSA 170
13.	Planet Cage		HSA 291	HSA 169
14.	Gear Ring		HSA 296	HSA 171
15.	Gear Ring Pawl Ring		HSA 307	HSA 172
16.	Spring for Pawl Ring		HSA 253	
17.	Ratchet Ring		HSA 304	
18.	RH Ball Ring		HSA 308	HSA 121[2]
	Inner Dust Cap		HSA 122[2]	HSA 122[2]
	Driver (not shown)			HSA 123[2]
19.	Driver and Brake Operating Pawls		HSA 311	
20.	Pawl Spring		HSA 469[3]	
21.	Lockwasher	HMW 150[1]	HMW 156	HMW 156
22.	Brake Arm Locknut	HMN 344[1]	HMN 334	HMN 135
23.	Axle Circlip	HSL 729	HSL 725	HSL 725
	Clutch Sleeve (not shown)			HSA 116[2]
24.	Axle 5¾"			HSA 173
	6"		HSA 313	
	6¼"		HSA 314	HSA 174
25.	Axle Key		HSA 295	HSA 124[2]
26.	Clutch		HSA 294	HSA 117[2]
	Thrust Ring (not shown)			HSA 283[24]
27.	Gear Indicator for 5¾" axle			HSA 125[2]
	6" axle		HSA 126[2]	
	6¼" axle		HSA 315	HSA 126[2]

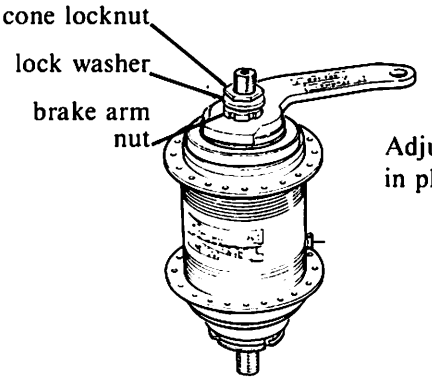
[1] The lockwasher, brake arm nut and brake arm as a unit may be interchanged.
[2] Same as AW.
[3] HSA 469 replaces HSA 302 (see Subassembly text).
[4] If thrust ring has same size opening at both ends, a thrust washer must be installed. This occurs only on older models.

HUBS

STURMEY-ARCHER S3C 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

(1) DISASSEMBLY

Loosen but *do not remove* cone locknut and brake arm nut.



Adjust bearing and lock brake arm nut in place with locknut.

ASSEMBLY 7

Next Step

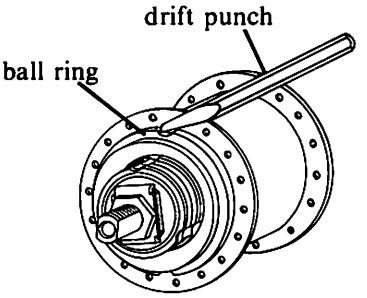
---

(2) DISASSEMBLY

Next Step

The right-hand ball ring may have a double start thread. If the ball ring is replaced in the opposite position, the wheel may need retruing. To facilitate proper reassembly, mark the ball ring at the point nearest the lubricator.

Place a drift punch as shown and loosen the ball ring by rapping the punch firmly with a hammer. *Do not try to unscrew it completely.*



Tighten right-hand ball ring with a hammer and drift punch.

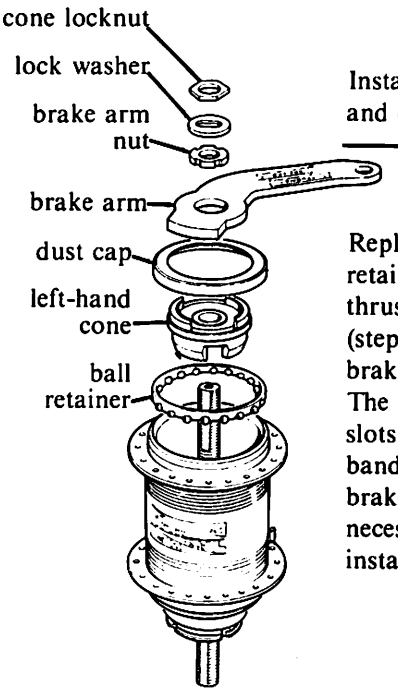
ASSEMBLY 6

Next Step

---

(3) DISASSEMBLY

Remove cone locknut, lock washer, and brake arm nut. The brake arm, dust cap and left-hand cone may come off separately or as a unit. They can easily be pressed apart if required. Remove ball retainer.



Next Step
Next Page

Next Step

Install brake arm nut, lock washer and cone locknut finger tight.

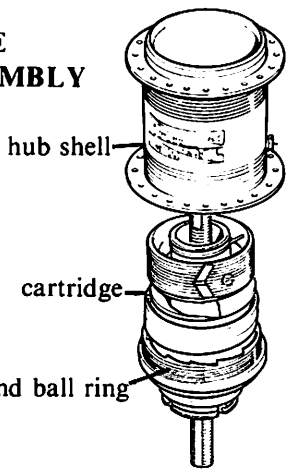
Replace ball retainer *flat side up*. If retainer will not seat properly, check thrust plate and pawl ring installation (step 3). Install cone, dust cover and brake arm (brand name facing out). The inward face of the cone has three slots; the two wide slots engage the brake band tabs, the narrow slot engages the brake actuating spring. It may be necessary to rotate the spring before installing the cone.

ASSEMBLY 5

STURMEY-ARCHER S3C 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

4 DISASSEMBLY

Unscrew right-hand ball ring from the *bottom* of hub shell and remove cartridge.



Next Step

Next Step Preceding Page

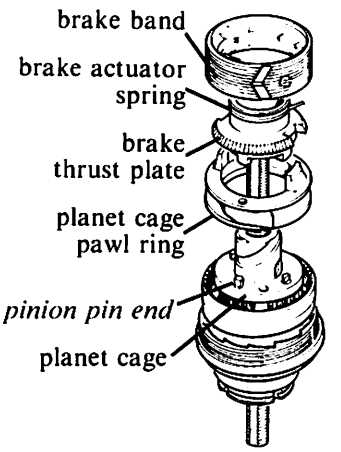
Without inverting cartridge, slip it into the hub shell and thread ball ring finger tight. If the mark made during disassembly is not beside the lubricator, remove and restart cartridge. Do not tip or invert hub until left-hand locknut has been installed in the next step.

ASSEMBLY 4

---

5 DISASSEMBLY

Remove brake band, thrust plate and planet cage pawl ring. If required brake actuating spring can be pried off thrust plate with a thin-bladed screwdriver.



Next Step

Turn assembly over. Install brake actuating spring on thrust plate if it was removed. *Viewed as shown hooked end of spring must be clockwise from gap.* Incorrect installation will cause excessive drag and wear.

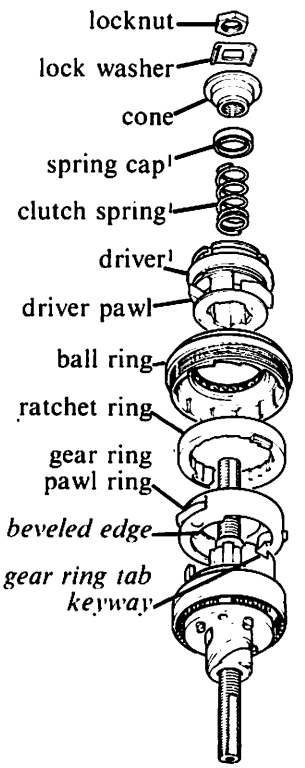
Rotate pinion pins so the flats face outwards. Insert tabs of planet cage pawl ring into slots on thrust plate. Screw the pawl ring and thrust plate onto the planet cage until pawl ring seats on the planet cage. Install brake band, *tabs up.*

ASSEMBLY 3

---

6 DISASSEMBLY

Hold down ball ring while removing right-hand locknut, lock washer, cone clutch spring, spring cap and driver[1] (rotate driver to disengage driver pawls). If driver catches on ball ring, remove both parts together; be careful not to damage pawl springs when separating them. Lift off ball ring, ratchet ring and gear ring pawl ring.



Next Step

Install ball ring. Push pawls in and rotate ring until seated over pawls. Install driver.[1] Push pawls in and turn driver clockwise until it seats in ball ring. Install spring and spring cap.[1] Install cone, lockwasher and locknut. Adjust bearing. If bearing runs rough, check spring cap.[1]

Replace gear ring pawl ring *beveled edge down.* Pawls must point clockwise when viewed from above. Top face of ring should be flush with top of gear ring tabs.

Install ratchet ring. Ratchet ring keys must be engaged in *keyways* of the gear ring tabs. If the keys are positioned *beside* the gear ring tabs, low gear may not engage properly.

ASSEMBLY 2

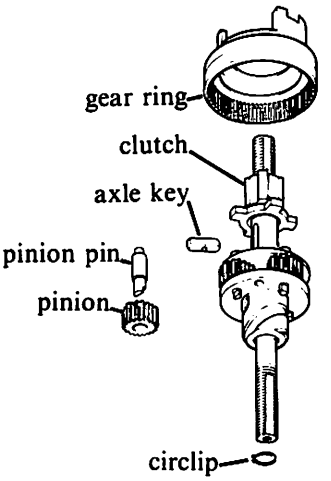
---

[1]Old model spring caps are too large to fit through the driver. On these hubs, the spring and cap are removed *after* and installed *before* the driver. Otherwise the spring cap will be compressed between the cone and the bearing with damage to both. Upon installation the driver must be held in place against the spring until the cone is installed.

7 DISASSEMBLY

Remove gear ring, clutch and axle key. Push out pinion pins and remove pinions.

Pry off planet cage circlip and remove planet cage.



Next Step
Preceding Page

Slide planet cage over left end of axle past circlip groove and replace circlip.

Replace pinions and pinion pins. Orient the pins as shown. Center axle key in the bottom of the axle slot with threaded hole parallel to axle. Slide clutch over axle key. Clutch should contact face of planet cage and engage pinion pins. Install gear ring.

ASSEMBLY 1

SUBASSEMBLIES

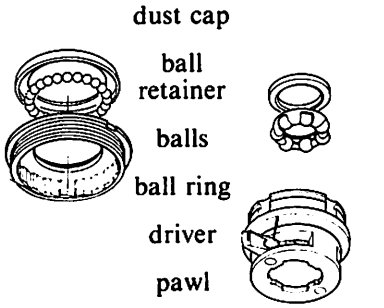
DISASSEMBLY

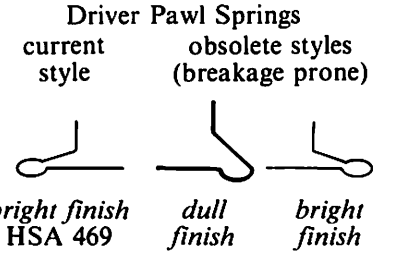
Ball Ring, Driver and Pawl Rings

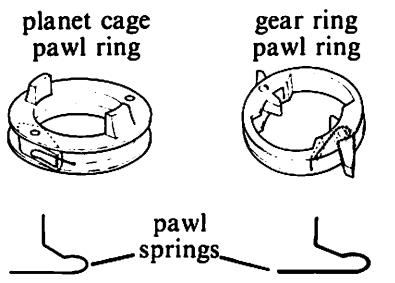
Bearings. Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out balls or ball retainer.

Pawls. Pawl springs can be removed with the pawls in place, although some deformation usually results. Ease the hooked end of the spring over the side or long end of pawl to the other side. Spread the ends of spring and slide out.

If pawls are to be removed, springs are best removed at that time. Riveted pawl pins can be removed only by drilling. Hollow pawl pins can be driven out with the correct size drift punch. Some drivers use removable pawl pins held in place by a circlip. *Do not mix up pawl springs.*







Ball Ring, Driver and Pawl Rings

Bearings. Install balls or ball retainer. *Orient retainer as shown.* Start dust cover straight by hand and tap home with a soft hammer.

Pawls. If only pawl springs have been removed, springs may be fitted with pawls in place. Use only new style pawl springs. Early types tend to break. Holding spring by hooked end, hook straight end around pawl pin beside pawl. Ease hooked end over the side or long end of pawl. Straight end must come to bear on piece body and hooked end on inside surface of pawl slightly behind driving edge.

If pawls were removed, install pawl, pawl spring and pin together. *Make sure pawls are oriented as shown.* Straight solid pins must be lightly riveted over. File end of pin flush. Hollow pins are driven in with a soft hammer. Grooved driver pawl pins are installed groove first and retained by a circlip around the driver.

ASSEMBLY

STURMEY-ARCHER S3C 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY (cont.)

CLEANING

Clean all parts, including outside of hub shell and axle bore, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

Part numbers followed by * refer to AW parts chart, others to S3C or TCW-III parts chart.

1. Clutch (26) and gear ring dogs (14) for rounded or chipped driving edges (rounding to a radius of even 1/64" (0.4 mm) at the corners can cause hub to slip out of gear)
2. Pawls (12*, 19, 21*), ball ring (18), left-hand ball cup (5) and ratchet ring (17) for rounded or chipped driving edges
3. Sun pinion (24), planet pinions (11) and gear ring (14) for worn or chipped teeth
4. Bearing surfaces of left-hand cone (3), left-hand ball cup (5), ball ring (18), driver (19), right-hand cone (5*) and pinion pins (12) for wear and pitting
5. Axle key (25) and indicator for stripped threads
6. Clutch spring (32*) and brake actuating spring (7) for size and tension
7. Dustcaps and ball retainers for straightness
8. All threaded parts for worn or damaged threads
9. Axle (24) for straightness
10. Planet cage (13) and thrust plate (8) threads for wear or roughness
11. Thrust plate (8) and brake band (6) serrations for wear
12. Brake band (6) and hub shell (5) for wear or glazing

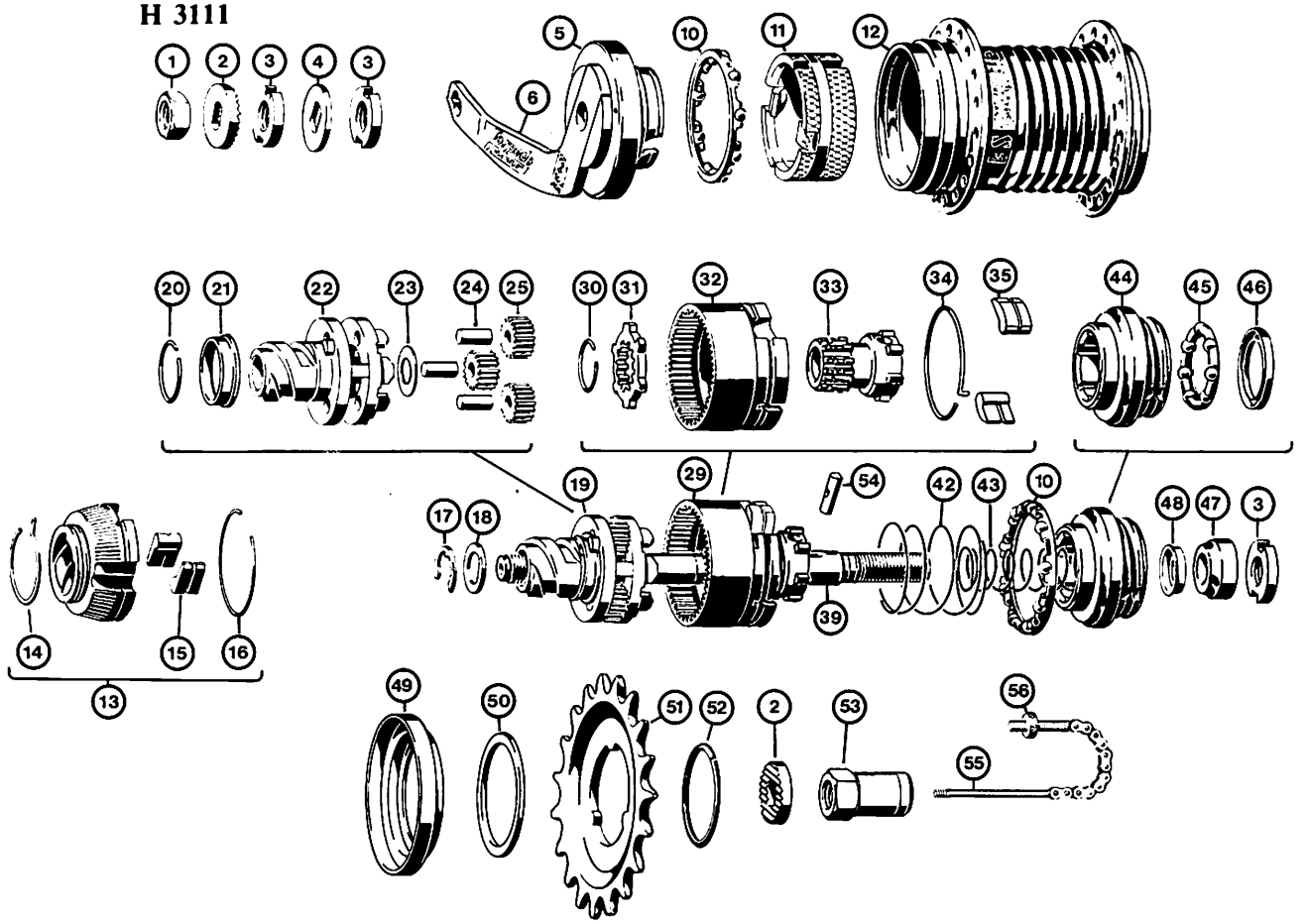
LUBRICATION

Lubricate ball retainers by filling the spaces between balls with grease. Lubricate hub shell and brake band liberally with a high-temperature grease. Be careful not to grease pawls. Lightly oil other internal parts with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.) Add about two teaspoons (8 ml) of oil when assembled.

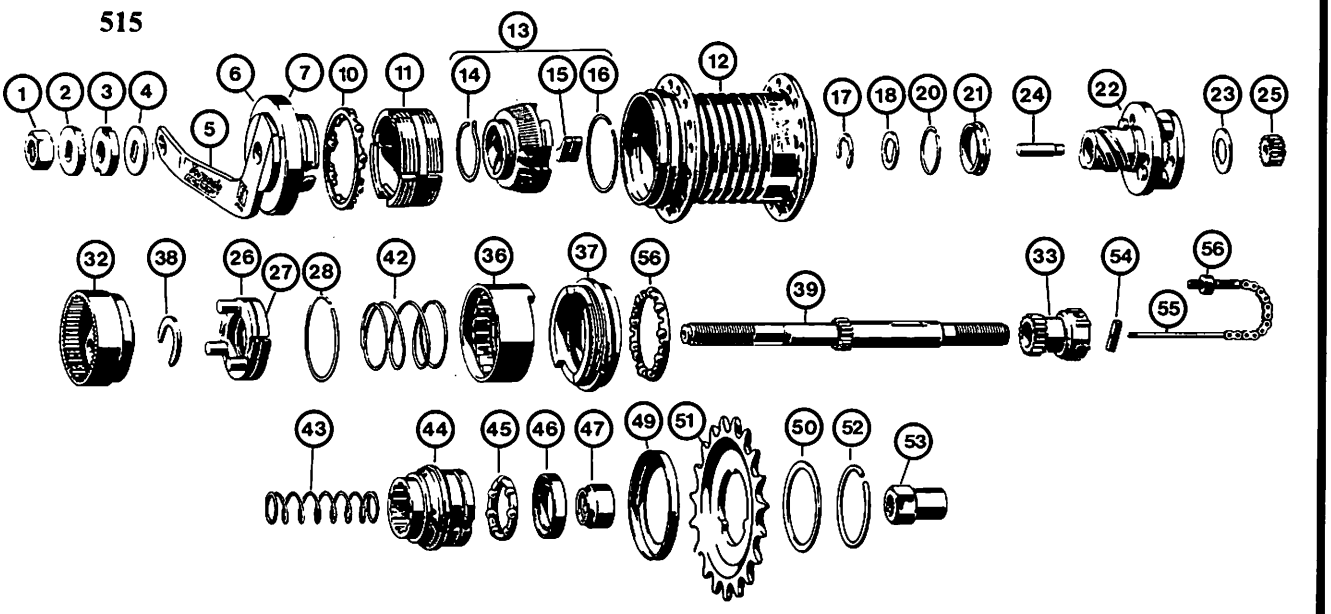
HUBS

F&S TORPEDO 3-SPEED HUBS WITH and WITHOUT COASTER BRAKE

H 3111



515



| Vertical line between numbers indicates parts are not interchangeable.

Parts are interchangeable only if they are on the same line and they do not have a vertical line between them.

[1] Interchanges with Duomatic 102 and 101.
[2] Interchanges with Automatic R 2110.
[3] Interchanges with Duomatic A 2110.
[4] See Sprocket Interchangability at beginning of Hub section.

F&S TORPEDO 3-SPEED HUB WITH AND WITHOUT COASTER BRAKE

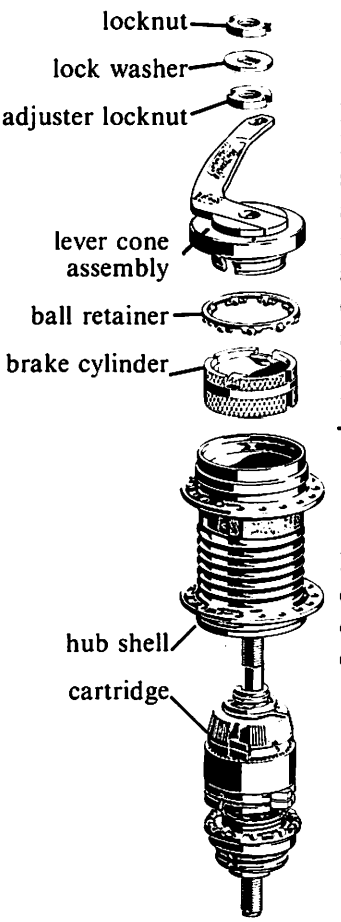
PARTS INTERCHANGEABILITY

Item #		3 speed with coaster brake Type H 3111	3 speed with coaster brake 515	3 speed without coaster brake 415
1.	Hex Nut (10.5 mm ϕ)	0516 003 000[1]	0516 003 000[1]	0516 003 000[1]
2.	Fixing Plate	0517 102 000[1]	0517 102 000[1]	0517 102 000[1]
3.	Locknut (10.5 mm ϕ)	0516 001 300[1]	0516 001 300[1]	0516 001 300[1]
4.	Lock Washer	0517 003 000[1]	0517 003 000[1]	0517 003 000[1]
5.	Lever Cone Assembly	0574 110 000	0574 107 100	
6.	Brake Lever	0519 014 300	0519 014 300	
7.	Dust Cap	0521 103 100	0521 103 100	
8.	Adjusting Nut			0516 023 000
9.	Adjusting Cone			0574 108 100
10.	Ball Cage	0576 104 100[1]	0576 104 100[1]	0576 104 100[1]
11.	Brake Shell (Brake Cylinder)	0573 103 100	0573 103 000	
12.	Hub Shell 36 holes	0501 118 000	0501 105 200	0501 108 200
	28 holes	0501 118 001	0501 105 202	0501 108 203
13.	Brake Cone Assembly	0574 106 000[2]	0574 106 000[2]	
14.	Friction Spring	0513 102 000[2]	0513 102 000[2]	
15.	Pawls	0536 104 100[23]	0536 104 000[23]	0536 104 100[23]
16.	Circlip	0512 102 100[23]	0512 102 000[23]	0512 102 100[23]
17.	Axle Circlip	0517 002 000[1]	0517 002 000[1]	0517 002 000[1]
18.	Thrust Washer	0518 103 000	0518 103 000	0518 103 000
19.	Planet Gear Carrier Assembly	0572 119 000	0572 105 200	0572 108 200
20.	Circlip	0512 104 000	0512 104 000	0512 104 000
21.	Locating Sleeve	0534 103 000	0534 103 000	0534 103 000
22.	Planet Gear Carrier	0502 112 000	0572 104 200	0572 107 200
23.	Thrust Washer	0518 106 000[1]	0518 106 000[1]	0518 106 000[1]
24.	Pivot Pins (Trunions)	0114 101 000[23]	0514 103 000	0514 102 200
25.	Planet Gear	0533 103 000[123]	0533 103 000[123]	0533 103 000[123]
26.	Pawl Carrier Assembly		0572 106 000	0572 106 000
27.	Pawl Carrier		0504 101 000	0504 101 000
28.	Circlip		0512 103 000	0512 103 000
29.	Gear Ring Assembly	0581 104 001		
30.	Circlip	0312 003 000		
31.	Dog Washer	0518 109 000		
32.	Gear Ring	0581 104 000	0533 105 200	0533 105 100
33.	Clutch Gear	0533 111 000	0533 104 000	0533 104 000
34.	Circlip	0512 115 000		
35.	Pawl	0536 109 000		
36.	Dog Ring		0501 107 200	
37.	Bearing Bush		0501 106 200	
38.	Gear Change Plate		0518 104 000	0518 104 000
39.	Axle 154 mm	0509 111 000	0509 104 200	
	167 mm	0509 112 000	0509 105 200	
	146 mm			0509 106 200
	159 mm			0509 107 200
40.	Ball Cup			0501 109 100
41.	Ball Retainer		0576 103 100	0576 103 100
42.	Pressure Spring (large diameter)	0525 104 100	0525 104 100	0525 104 100
43.	Pressure Spring (small diameter)	0525 013 200	0525 013 200	0525 013 200
44.	Driver Assembly	0572 118 000	0572 103 200	0572 103 200
45.	Ball Cage	0576 102 000	0576 102 000	0576 102 000
46.	Dust Cap	0121 108 000	0121 108 000	0121 108 000
47.	Fixed Cone	0508 105 000	0508 102 100	0508 102 100
48.	Cap	0521 108 000		
49.	Dust Cap (sprocket)	0121 109 000	0521 104 000	0521 104 000
50.	Spacer Washer[4]	0518 018 000	0518 018 000	0518 018 000
51.	Sprockets[4]			
52.	Circlip[4]	0512 011 000	0512 011 000	0512 011 000
53.	Chain Guide Nut	0579 100 000	0579 100 000	0579 100 000
54.	Axle Key (sliding block)	0527 100 100	0527 100 100	0527 100 100
55.	Small Pull Rod	0587 100 101	0587 100 101	0587 100 101
56.	Knurled Nut	0516 027 000	0516 027 000	0516 027 000
57.	Ball Cage		0576 103 100	0576 103 100

F & S TORPEDO H 3111 3-SPEED COASTER BRAKE DISASSEMBLY AND ASSEMBLY

1 DISASSEMBLY

Remove left-hand locknut, lock washer and second locknut. Remove lever cone assembly. The brake lever, lever cone and dust cap are press fit together and should not be forced apart. Lift out ball retainer and brake cylinder. Lift hub shell off cartridge.



Next Step

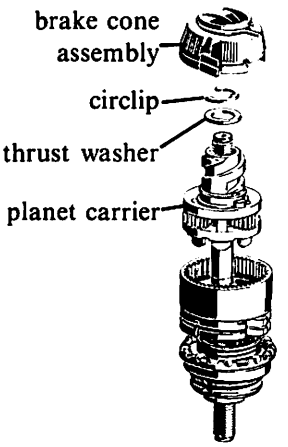
Install ball retainer *flat side up*. Install lever cone assembly. If the brake arm, lever cone and dust cap were forcibly separated, they may have been damaged and should be replaced. If serviceable, press together with brand name on brake arm facing out. Slots in lever cone engage tabs on brake cylinder. Install adjuster locknut, lock washer and locknut. Adjust bearing, locking the first nut in place with the second.

Position hub shell with *long end up*. Slip hub shell over assembly. Install brake cylinder with tabs up. Rotate until one of the narrow slots in the brake cylinder engages hooked end of friction spring.

ASSEMBLY 3

2 DISASSEMBLY

Rotate brake cone assembly counter-clockwise and remove. Remove circlip and thrust ring. Lift off planet carrier.



Next Step
Next Page

Next Step

Invert assembly. Install planet carrier and thrust washer (washer flat must be started on *long* axle flat). Push down and rotate carrier to expose circlip groove. Install axle circlip. Install brake cone assembly *wide end down*.

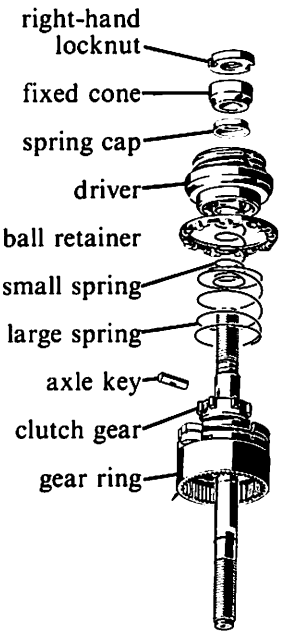
ASSEMBLY 2

F & S TORPEDO H 3111
3-SPEED COASTER BRAKE
DISASSEMBLY AND ASSEMBLY (cont.)

3 DISASSEMBLY

Invert assembly. Remove right-hand locknut, fixed cone, small diameter spring and spring cap. Remove driver, ball retainer and large diameter spring.

Rotate clutch gear until horizontal holes line up with axle keyway. Push axle key out large hole. Lift off gear-ring/clutch-gear assembly.



Position axle assembly vertically with right (hollow) end up. Slip gear-ring/clutch-gear assembly over axle with gear ring facing down.

Rotate clutch gear until horizontal holes line up with axle keyway. Insert sliding key *rounded side down* through large hole. When key is fully inserted, clutch gear and gear ring rotate freely. Slip both springs over axle, install spring cap on small spring. Slip retainer *flat side up* and driver over axle. Install fixed cone and start locknut. While tightening locknut hold driver down against gear ring. Tighten locknut until cone bottoms on axle shoulder.

ASSEMBLY 1

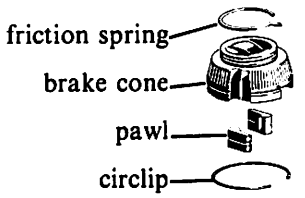
SUBASSEMBLIES

DISASSEMBLY

Brake Cone

Remove friction spring only if it is to be replaced. Ease spring out of groove with a thin-bladed screw driver.

To remove pawls, pull outward until end of circlip clears groove, then ease circlip off the end of brake cone.



Brake Cone

Install friction spring *with hooked end clockwise from gap.* Incorrect installation will cause excess drag, wear and possible brake failure.

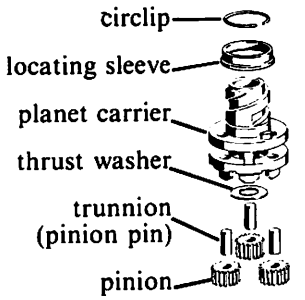
Install pawls under straight-ended circlip Position ends of circlip near indentations that close circlip groove. *Viewed as shown, pawls must point counter-clockwise.*

ASSEMBLY

DISASSEMBLY

Planet Carrier

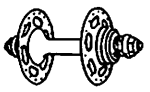
Remove circlip and locating sleeve. Push out trunnions (pinion pins) and remove pinions. Extract thrust washer from inside planet carrier.



Planet Carrier

Install thrust washer, planet pinions and trunnions (pinion pins). *Install locating sleeve flange down.* Install circlip.

ASSEMBLY

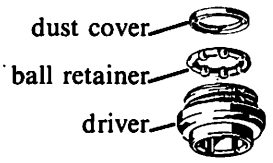


HUBS

DISASSEMBLY

Driver

Remove dust cover with a thin-bladed screwdriver. Work slowly around cover to avoid deforming it. Lift out ball retainer.



Driver

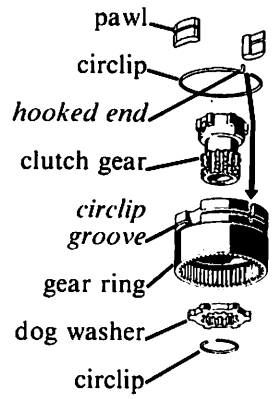
Install ball retainer flat side up. Start dust cover straight and tap home with a soft hammer.

ASSEMBLY

DISASSEMBLY

Gear-Ring/Clutch-Gear

To remove pawls, pry straight end of circlip out of groove and ease over end of gear ring. To separate clutch gear and gear ring use an awl to remove circlip. Remove dog washer and clutch gear.



Gear-Ring/Clutch-Gear

Install clutch gear and dog washer; lock in place with circlip. Position assembly with gear ring teeth down. Install pawls under hooked circlip. *Pawls must point clockwise when viewed from above.* Hooked end of circlip should lie in the slot that intersects circlip groove.

ASSEMBLY

CLEANING

Clean all parts, including outside of hub shell, in a suitable solvent. Be very careful not to introduce dirt or grit after cleaning.

POINTS TO CHECK

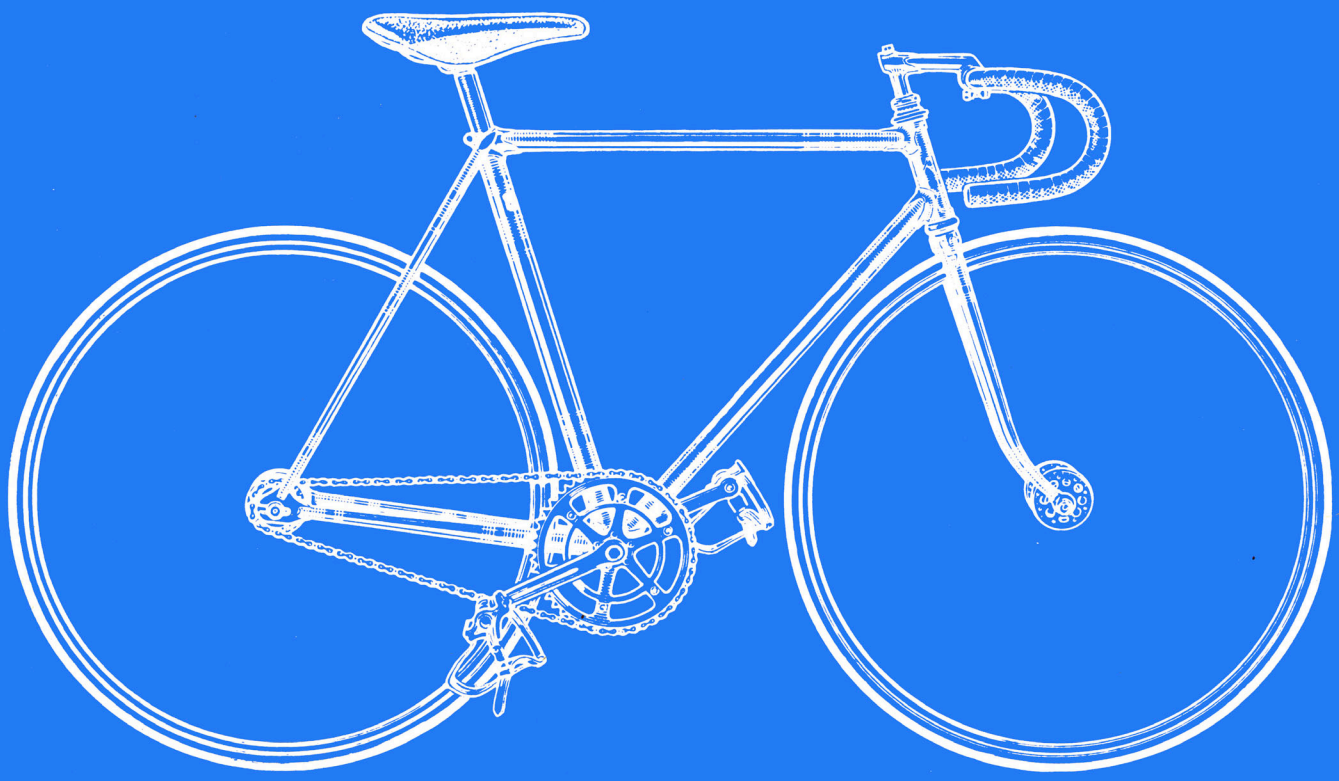
Numbers in parenthesis refer to parts chart and exploded drawing.

1. Pawls (15, 35) and ratchets for rounding or chipping
2. Gear teeth in gear ring (32), on planet pinions (25) and on axle (39) for worn or chipped teeth
3. Planet carrier (22), gear ring (32), dog ring (36), clutch gear (33) and driver (44) for worn or rounded teeth
4. Bearing surfaces of lever cone (5), hub shell (12), ball cup (40), driver (44), fixed cone (47) and pinion pins (24) for wear or pitting
5. Brake cylinder (11) and hub shell (12) for wear or glazing
6. Brake cone (13) for worn serrations
7. Friction spring (14), pressure springs (42, 43), circlips (16, 34) for size and tension (manufacturer recommends replacing circlips at overhaul)
8. Axle (39) for straightness
9. Dust caps (7, 46, 49), bearing retainers (10, 41) for straightness
10. All threaded parts for worn or damaged threads
11. Axle key (54) for stripped threads

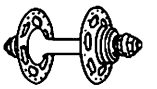
LUBRICATION

Lubricate ball bearings by filling the spaces between balls with grease. Be careful not to grease pawls. Lubricate hub shell, brake cylinder and friction spring liberally with a high-temperature grease for *steel* brake shoes. Oil, never grease, brake cone and gear ring with a *good* cycle oil. (WD-40 is too light for lasting lubrication, 3-in-1 Oil gums up with age.)

Front, Freewheel and Other Hubs



HUBS



HUBS—HUB AXLES

FRONT HUBS

BALL SIZES: Most front hubs use 10-3/16" balls per side except the following:

ACS 9-15/64" balls per side

Campagnolo (Record and Super Record) 9-7/32" balls per side
(Current Nuovo Tipo hubs) 10-3/16" balls per side

Normandy Competition old style (with shallow cut cone) 12-3/16" balls per side

Zeus Gran Sport 9-7/32" balls per side

USA RETAINERS

Retainer	No. of balls per retainer	Diameter of balls	Manufacturer
23	8	1/4"	Bendix Heavy Duty
42	10	1/4"	Bendix Trailer Hub
10	5	1/4"	Excel Mark VII
5	7	3/16"	Excel Mark 60
10	5	1/4"	Monark Silver King
13	7	1/4"	Musselman
5	7	3/16"	New Departure Model Y
3201A	7		Schwinn
5 Skived	7	3/16"	Schwinn Union
5	7	3/16"	Union Regular
4962H			Union Heavy Duty
13	7	1/4"	Westfield

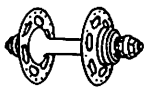
REAR HUBS—MULTI SPEED FREEWHEEL

BALL SIZES: 9-1/4" balls per side
Except the following:
ACS 9-15/64" balls per side
Schwinn Disc Brake 12-3/16" balls per side

➡ Right hand hub cones tend to rotate and tighten toward the center, eventually cracking the hub shell. Tighten the right cone and locknut firmly against each other and make adjustments on left side.

When installing Phillips or Raleigh hubs with fixed cones that butt against a shoulder on the axle, be sure the fixed cone is on the right and adjusting cone with flats is on the left.

On Schwinn front hubs without cone locknuts, be sure the cone lockwasher is on the right side.



HUBS

REAR HUB DIMENSIONS

NATIONAL TENDENCIES

There are many exceptions, so measure if in doubt. Top quality road racing equipment is often close to Campagnolo. Make up for differences by adding, removing or relocating washers and spacers. If axle length won't allow the change, squeeze or spread tips. Align tips with proper tool after altering width. Never use the action of a quick release unit to squeeze the tips together.

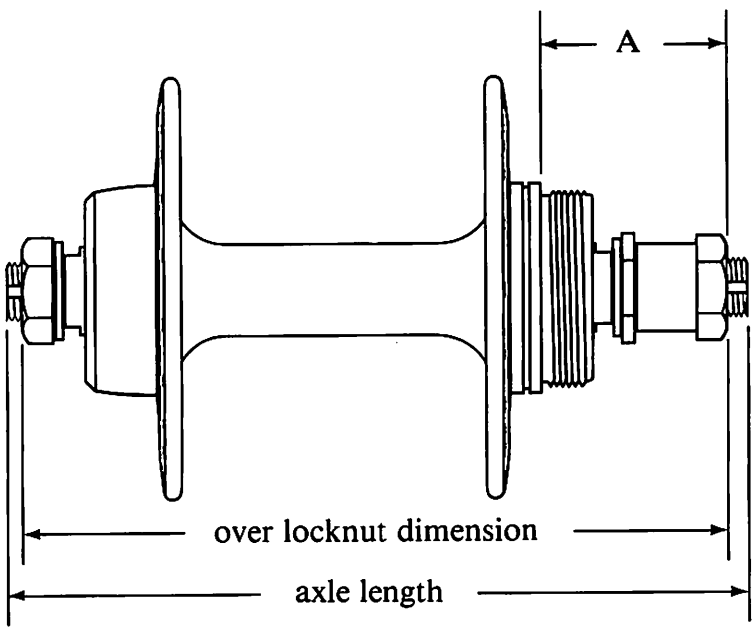
FREEWHEEL CLEARANCE

Dimension A for 5-speed freewheels varies between 28.5mm (1 1/4") and 35mm (1 3/8"). Campagnolo measures 30mm for A. Campagnolo and similar hubs must be used on frames that have the end of the right stays flattened so chain easily clears and wheel can be removed.

TO MEASURE DIMENSION A

Hold a piece of square bar (a square shank screw driver for approximate measure) against the locknut and axle so that it's perpendicular to the axle, then measure the distance between the face the freewheel butts against and the bar.

6-SPEEDS—convert a rear hub to a 6 speed by rearranging washers and spacers and/or by lengthening the axle and adding washers or spacers. Dimension A must be a minimum 34mm, but preferably 36mm. Rearranging washers and spacers may cause problems on the freewheel side by making spokes too close to perpendicular.

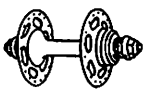


HUB AND AXLE DIMENSIONS

FRONT	Thread	Over Locknuts	Axle Length
ENGLISH			
Solid	5/16" x 26 TPI	too many variations	
FRENCH			
Solid	8mm x 1.0 (or 26 TPI)	96 (3 3/4")	132 (5 3/16")
Hollow	9mm x 1.0 (or 26 TPI)	96 (3 3/4")	105 (4 1/8")
ITALIAN			
Solid	8mm x 26 TPI	102 (4")	135 (5 5/16")
Hollow	9mm x 26 TPI	102 (4")	111 (4 3/8")
JAPANESE			
Solid	5/16" x 26 TPI, 3/8" x 26 TPI, 9mm x 1.0mm	93 (3 3/4")	132 (5 3/16")
Hollow	3/8" x 26 TPI 9mm x 1.0mm	96 (3 3/4")	104 (4 1/8")
CAMPAGNOLO			
Solid—Nuovo Tipo	8mm x 26 TPI	100 (3 15/16")	132 (5 3/16")
Solid—Track	9mm x 26 TPI	100 (3 15/16")	139 (5 1/2")
Hollow	9mm x 26 TPI	100 (3 15/16")	108 (4 9/32")

*Notes below with asterisk apply to freewheels with normal spacing.

REAR				Dimension A
ENGLISH				
Solid	3/8" x 26 TPI	too many variations		
FRENCH				
Solid	9.5mm x 1.0 (or 26 TPI)	122 (4 13/16")	160 (6 1/4")	34
Hollow	9.5mm x 1.0 (or 26 TPI)	122 (4 13/16")	133 (5 1/4") *135 six speed	34
ITALIAN				
Solid	9.5mm x 26 TPI	122 (4 13/16")	155 (6 1/8")	34
Hollow	9.5mm x 26 TPI	122 (4 13/16")	132 (5 3/16")	34
JAPANESE				
Solid	3/8" x 26 TPI, 10mm x 1mm	125 (4 15/16")	165 (6 1/2")	35
Hollow	3/8" x 26 TPI 10mm x 1mm	125 (4 15/16")	132 (5 3/16")	35
CAMPAGNOLO				
Solid—Nuovo Tipo	9.5mm x 26 TPI	121 (4 3/4")	155 (6 1/8")	34
Solid—Track	10mm x 26 TPI	110 (4 3/8")	149 (5 7/8")	21.5
		121 (4 3/4")	159 (6 1/4")	24
Hollow	10mm x 26 TPI	121 (4 3/4")	*129 for 5 speed only	30
		125 (4 29/32)	*134 for 6 speed only	35
			*132 just enough for 6 speed	



HUBS

THREAD CHASER MARKINGS

Bicycle Research

type	size	marking	notes
TC-1	8mm x 26 TPI	small (1/2") hex, no groove	
TC-2	9.5mm x 26 TPI	large (9/16") hex, no groove	
TC-3	5/16" x 24 TPI	small (1/2") hex, 1 groove	Also fits X caliber skateboard trucks
TC-4	3/8" x 24 TPI	large (9/16") hex, 1 groove	
TC-5	5/16" x 26 TPI	small (1/2") hex, 2 grooves	
TC-6	7.5mm	small (1/2") hex, 3 grooves	Fits Chicago skateboard trucks
TC-7	3/8" x 26 TPI	large (9/16") hex, 2 grooves	Some skates

QUICK RELEASE UNITS

Atom	5mm x 0.90mm
Brev. Stop	5mm x 0.80mm
Campagnolo	5mm x 0.80mm
Gnutti	5mm x 0.80mm
Milremo	5mm x 0.90mm
Normandy	5mm x 0.90mm
Pelissier	5mm x 0.90mm
Schwinn Approved (made in France)	5mm x 0.90mm
Shimano	5mm x 0.80mm
Simplex Old Style*	5mm x 0.75mm
Simplex New Style*	5mm x 0.80mm
Weyless	.25" x28 TPI
Zeus	5mm x 0.80mm

*Simplex old style has plastic wing nut; Simplex new style is all metal.

MARKINGS ON VAR FREEWHEEL REMOVERS

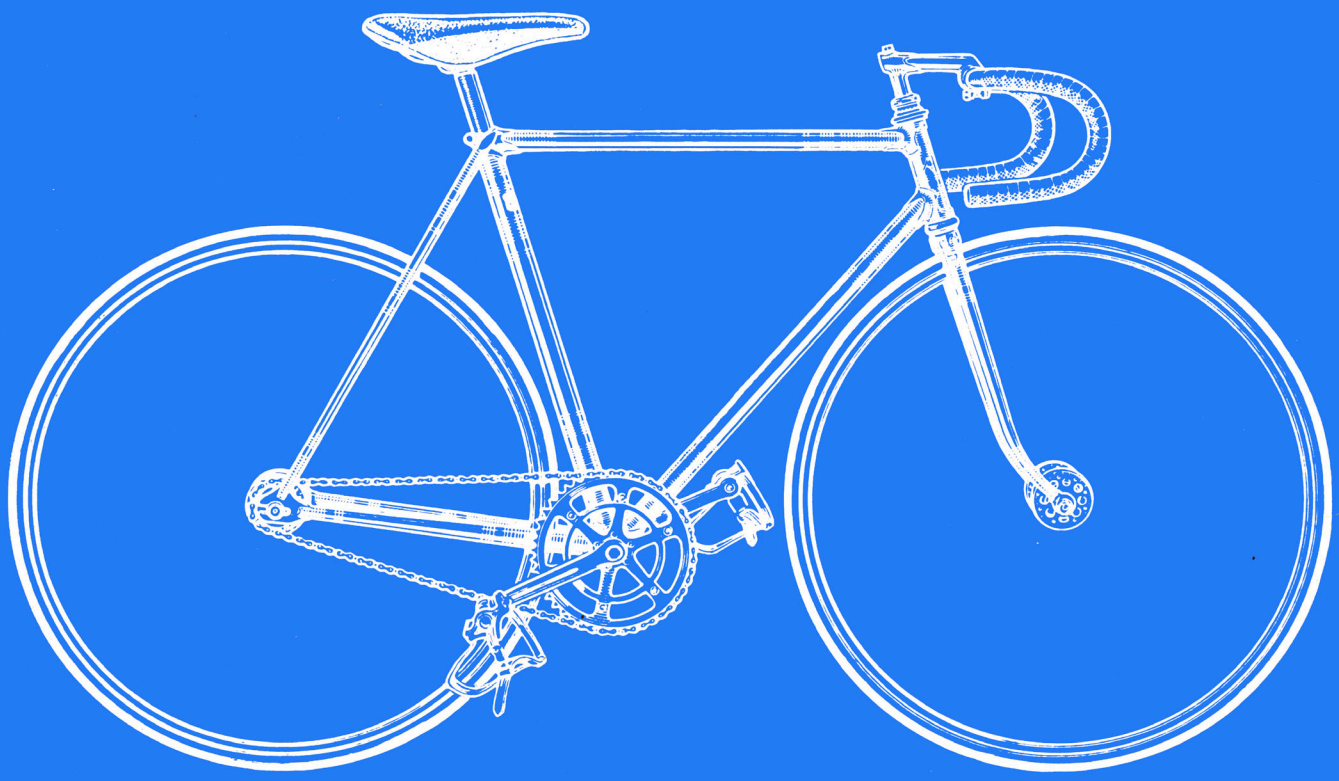
Models 186 and 188

mark	quick release thread size	fits quick release units
BA	5mm x .90mm	Atom, Normandy, others
BC	5mm x .80mm	Campagnolo, others
BS	5mm x .75mm	Old Style Simplex

Locking sleeves for the Var 01 freewheel tool are marked as follows:

9.5 to indicate	9.5mm x 1.00mm
5.90 to indicate	5mm x 0.90mm
5.80 to indicate	5mm x 0.80mm
5.75 to indicate	5mm x 0.75mm

Spokes, Rims, Tires

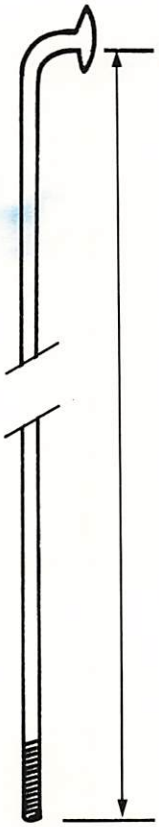


SPOKES, RIMS, TIRES

HOW TO USE THE SPOKE CHART

UTILITY WHEELS

1. Examine the hub and the size flanges it has. Determine which of the nine general Hub Diameter categories it fits into. Sample hubs are listed on Chart 1.
2. Turn to the chart for the rim size you are using
   Chart 1 — 27", 28", 700C, and standard sew up rims
   Chart 2 — 26" rims
   Chart 3 — 24" and 22" rims
   Chart 4 — 20" rims
   Chart 5 — 18" and 16" rims
   Chart 6 — 14" rims
3. Count the number of holes in the hub and decide on a spoking pattern, i.e., 4 cross, 3 cross, etc. Look up this combination on the tables. The spoke lengths listed on these tables are for a theoretical rim.
4. Go to the rim correction table and look up the rim you are using. Subtract the number in the right hand column from the spoke length for the theoretical rim and you have the spoke length you need.



spokes are measured from the inside of the bend to the end

EXAMPLE:

27 x 1 1/4 Sturmey Archer EA 25.0
Normandy Standard High Flange
36 spokes, 3 Cross spoking pattern

1. Looking on Chart 1 Normandy Standard High Flange is listed under "63mm HUB DIAMETER Fair to good quality high flange"
2. 27 x 1 1/4 rims are listed on Chart 1
3. The Hub has 36 holes and it is to be built 3 cross. Looking on chart 1 under 63mm HUB DIAMETER go to the right hand side of the page. This combination has a theoretical spoke length of 301.
4. Go to the Chart 1 Rim Correction Tables. Under Sturmey Archer EA 25.0 a correction factor of -4 is listed. Subtract 4 from 301.

$$\begin{array}{r} 301 \\ -4 \\ \hline 297 \end{array}$$

297 is the spoke length to use for the above combination of hub and rim.

➡ Spoke lengths are calculated to come to the bottom of the slot in a Union spoke nipple. On the right side of rear wheels with multispeed freewheels the end of the spoke will be flush with the end of the nipple. Or subtract 2mm from the calculated spoke length and the spoke will come to the bottom of the slot in the nipple.

SPOKES, RIMS, TIRES

HOW TO USE THE SPOKE CHART (cont.)

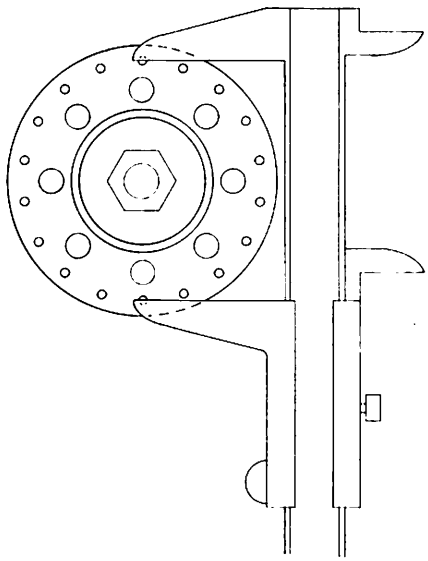
➡ Suppliers won't be able to supply every spoke length listed.

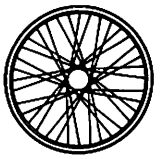
For most rims the spoke lengths listed should be considered the maximum. For rims with recessed nipple seats spoke lengths listed can be 2 or 3 millimeters longer if there are enough threads on the spoke.

Lengths listed in light numbers will work only with exact Hub Diameters listed as The General Categories.

HUB MEASURING

Hubs are measured from spoke hole center to spoke hole center.

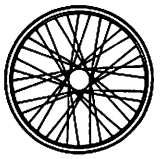




➡ Union spokes are used in these charts. Other spokes are measured in different ways and may even stretch differing amounts. Measure the spokes you use; compare them to the measurements printed on the box they are packaged in. You may have to add or subtract a millimeter or two to come up with consistently satisfactory results.

LARGE FLANGE HUBS

When building wheels with large flange hubs, check the angle at which the nipple enters the rim. Breakage will occur if the spoke nipple is stressed at this point. Rims are sometimes dimpled to make up for this. Some nipples will work at a bigger angle from perpendicular than others. Try it in the spoke hole to see. Problems usually happen when using a drum brake or other extra large flange hub and a 3 or 4 cross pattern. Other problems can happen when combining a large flange hub with a 20 or 24 inch rim. The solution is to use a 2 or 1 cross spoke pattern.



SPOKES, RIMS, TIRES

CHART 1 27" WHEELS

34 mm HUB DIAMETER

Generally: Fair to Good Quality
Small Flange Front Hubs

	Diameter
Milremo	34
Raleigh	34
Schwinn	36
Union	33.5

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**310**	**306**	302	299	298
36	**313**	**307**	302	299	298
32	—	**309**	303	300	298
28	—	312	305	300	298
24	—	—	307	301	298

40 mm HUB DIAMETER

Generally: Good to High Quality
Small Flange Front Hubs

	Diameter
Campagnolo Record and Nuovo Tipo	39
Favorit	37.5
Shimano Dura—Ace	38
Zeus	40

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**310**	**304**	299	296	295
36	**312**	**306**	300	296	295
32	—	**308**	302	297	295
28	—	311	303	297	295
24	—	—	306	298	295

44.5 mm HUB DIAMETER

Generally: Small Flange Rear Hubs

	Diameter
Atom	44.8
BFC Hub Brake small flange	42.5
Campagnolo Record and Nuovo Tipo	44.5
Dyno Hub small flange	42.5
Milremo	45
Normandy	44.8
Prior	44.5
RFG Single Speed Fixed Gear/Freewheel	42.5
Shimano Dura-Ace	44.5
Shimano 333	44.5
Zeus	44.5

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**309**	**303**	298	294	293
36	**312**	**305**	299	295	293
32	—	**307**	299	295	293
28	—	311	302	295	293
24	—	—	305	296	293

SPOKES, RIMS, TIRES

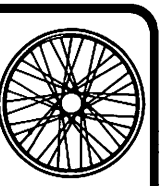


CHART 1 27" WHEELS (cont.)

48 mm HUB DIAMETER

Generally: Medium Flange and Coaster Brakes

	Diameter
Favorit Medium Flange Rear	48
Phil Wood Standard Flange	48.5
Sunshine Rear	46
Sunshine Front	48
Weyless	48

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**309**	**302**	296	293	291
36	**312**	**304**	297	293	291
32	—	**307**	298	293	291
28	—	311	301	294	291
24	—	—	304	295	291

58 mm HUB DIAMETER

Generally: Internally Geared 3 speeds and Torpedo 2 speeds

	Diameter
Shimano 3 speeds	59
Torpedo 3 speeds	58
Torpedo 2 speeds	58
Everest and Jennings wheelchair	55

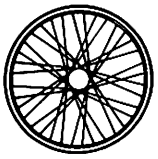
no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**308**	**299**	292	288	286
36	**312**	**302**	294	288	286
32	—	**305**	295	289	286
28	—	**310**	298	289	286
24	—	—	302	291	286

63 mm HUB DIAMETER

Generally: Fair to Good Quality Large Flange Front and Rear

	Diameter
Excellto Super Competition	62.3
Gnutti	63
Italian 3 Piece hub shell	62.5
Italian 1 Piece hub shell	62.8
Milremo	62.5
New Star	62
Normandy Standard	63
Schwinn Approved Made in France	63
Shimano	63
Shimano 3 speed	59
Sunshine	63.4

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**307**	**298**	290	286	284
36	**311**	**301**	292	286	284
32	—	**304**	294	286	284
28	—	310	297	287	284
24	—	—	301	288	284



SPOKES, RIMS, TIRES

CHART 1 27" WHEELS (cont.)

67 mm HUB DIAMETER

Generally: Quality
Large Flange Front and Rear

	Diameter
Campagnolo Record	67
Campagnolo Nuovo Tipo	67.2
Gnutti	66
Normandy Competition	67
Phil Wood	67.5
Shimano	67
Sunshine	67
Sturmey Archer AW, FW	66
Resilion*	70
Zeus	66.5

*Subtract 1 mm for final length

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**307**	**297**	289	284	282
36	**311**	**300**	290	284	282
32	—	**304**	293	285	282
28	—	310	296	286	282
24	—	—	300	287	282

90 mm HUB DIAMETER*

Generally: Aluminum Shell Drum Brakes

	Diameter
Atom	89.5
GriMeCa	87

*These values work only for evenly spaced spoke holes.

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**304**	**290**	279	272	270
36	**310**	**295**	282	273	270
32	—	**300**	285	274	270
28	—	308	289	275	270
24	—	—	295	277	270

102.5 mm HUB DIAMETER

High flange side of Dyno Hub and BFC Hub Brake

no. of spokes	no. of crosses 4X	3X	2X	1X	radial
40	**304**	**288**	276	267	264
36	**311**	**293**	278	268	264
32	—	**299**	281	269	264
28	—	308	286	270	264
24	—	—	293	272	264

SPOKES, RIMS, TIRES

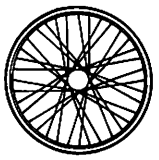
CHART 1 27" WHEELS (cont.)

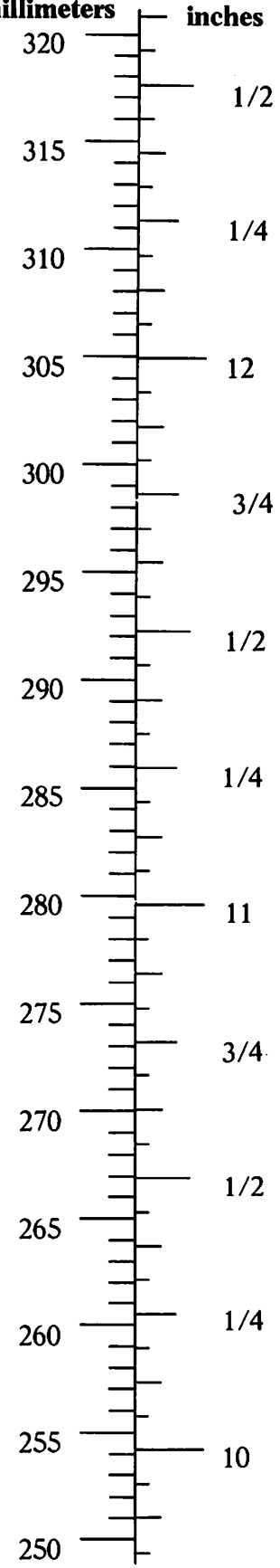
27" Rim Corrections (includes 27", 700C, 28" and Sew Ups)

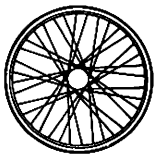
27" x 1 1/4 (23—630 thru 32—630)			
Araya	— 3	— 5	
Ambrosio	— 3		
Dunlop			
Special Lightweight	— 2		
Fiamme	— 3		
Huffy	— 6		
Mavic	— 2	— 7	
Marzorati MP	— 3		
Milremo	— 5	— 5	
Murray (M.O. Mfg)	— 3		
Nisi	— 3		
Raleigh (see Sturmey Archer)			
Rigida	— 4	— 6	
Schwinn S-6	— 5		
Sturmey Archer EA 25.0	— 4		
Sturmey Archer Lightweight			
LW K25.0	— 2		
Super Champion			
with eyelets	— 5	— 5	
without eyelets	— 6		
Ukairim	— 3		
Weinman — dimpled	— 4		
non dimpled	— 3	— 5	
124, 129			— 2

700C, 28 x 1 5/8 x 1 3/8 (23—622 thru 32—630)	SEW-UPS	WIRED ON RIMS		
Araya		— 7	— 9	
Blue Spot	— 6			
Red Spot	— 5			
AVA	— 9	— 6		
Fiamme — Ergal,		— 6		
Yellow Label (Road & Track)	— 6			
Red Label	— 7			
Mavic		— 4	— 9	
Bleue, Monthlery, OR10	— 6			
OR 7, Special Sport	—7			
Martano	— 6			
Milremo		— 9	—9	
Nisi	— 4			
Rigida		— 7	— 10	
Super Champion		— 9	— 9	
Arc-en-Ciel, Record du Monde	— 6			
Etoile, Medaille d'Or	— 7			
Ukai	— 6			
foam filled	— 0			
Weinmann				
Dimpled		— 9		
Non Dimpled		— 8	— 12	
124, 129				— 5
w/rim washers	— 6			
w/eyelets	— 8			

NOT INTENDED FOR MEASURING COMPARATIVE SCALE ONLY







SPOKES, RIMS, TIRES

CHART 2 26" WHEELS

34 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
36	**298**	**292**
32	—	**294**
28	—	**297**

40 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
36	**297**	**291**
32	—	**293**
28	—	**296**

44.5 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
40	**294**	**288**
36	**297**	**290**
32	—	**293**
28	—	**296**

48 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
40	**294**	**287**
36	**297**	**289**
32	—	**292**
28	—	**296**

58 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
40	**293**	**284**
36	**297**	**287**
32	—	**290**
28	—	**295**

63 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
40	**292**	**282**
36	**296**	**286**
32	—	**289**
28	—	**295**

67 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X
40	**292**	**282**
36	**296**	**285**
32	—	**289**
28	—	**294**

90 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**289**	**275**	**265**
36	**295**	**280**	**267**
32	—	**285**	**270**
28	—	**293**	**275**

102.5 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**289**	**273**	**261**
36	**296**	**278**	**263**
32	—	**284**	**267**
28	—	**293**	**271**

SPOKES, RIMS, TIRES

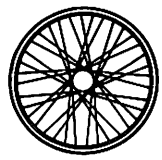


CHART 2 26" WHEELS (cont.)

26" Rim Corrections (includes 650B)

26 x 1 3/8 EA3 (37—590)

Ambrosio	— 8
Araya	— 9
M.O. Mfg. Co.	— 8
Schwinn (see EA1)	
Raleigh	
EA 23.0	— 9
(Sturmey Archer) R 23.0	— 10
Rigida	— 8

26 x 1 1/4 EA1 (32—597)

Araya	— 4
Raleigh EA 23.5	— 4
Rigida	— 5
Schwinn S-5	
(26 x 1 3/8)	— 7
Schwinn S-6	
(26 x 1 3/8)	— 5

26 x 1 3/4 (47—571)

Schwinn S-7	— 19

26 x 1.75 (44—559)

Araya (steel, alloy)	— 26
Murray	— 26
Sun Metal	— 25

26 x 2.125 (47—559)

Schwinn S-2	— 26

650B 26 x 1 1/2 (40—584)

Super Champion	— 13
Weinman	— 11

Sew Ups

Nisi w/washer	—9

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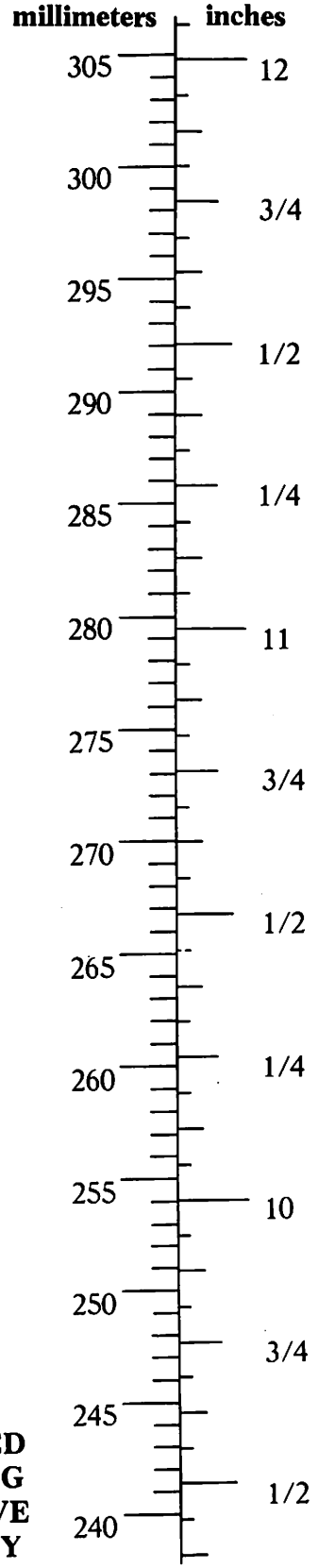
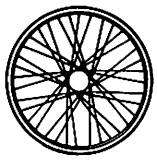




SPOKES, RIMS, TIRES

CHART 3

24" AND 22" WHEELS

34mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
36	**268**	**262**	—
32	—	**264**	—
28	—	**267**	—
24	—	—	**262**

40mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
36	**267**	**261**	—
32	—	**263**	—
28	—	**266**	—
24	—	—	**261**

44.5mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**264**	**258**	—
36	**267**	**260**	—
32	—	**262**	—
28	—	**266**	—
24	—	—	**260**

48mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**264**	**257**	—
36	**267**	**259**	—
32	—	**262**	—
28	—	**266**	—
24	—	—	**259**

58mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**263**	**254**	**248**
36	**267**	**257**	**249**
32	—	**261**	**251**
28	—	**265**	**253**

63mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**262**	**253**	**246**
36	**266**	**256**	**247**
32	—	**259**	**249**
28	—	**265**	**252**
24	—	—	**256**

67mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**262**	**252**	**244**
36	**266**	**255**	**246**
32	—	**259**	**248**
28	—	**264**	**251**
24	—	—	**255**

90mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**259**	**245**	**235**
36	**265**	**250**	**238**
32	—	**255**	**241**
28	—	**263**	**245**
24	—	—	**250**

102.5mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**259**	**243**	**231**
36	**266**	**248**	**234**
32	—	**254**	**237**
28	—	**263**	**242**
24	—	—	**248**

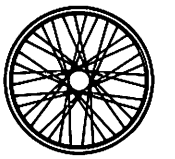


CHART 3 24" and 22" WHEELS (cont.)

24" and 550A Rim Corrections

24 x 1 3/8 (37—540)

Araya	— 4
Raleigh (Sturmey Archer) R 21.0	— 6
Rigida	— 4
Schwinn S-5 (see 24 x 1 1/4)	
Sturmey Archer EA 21.0	— 3
Ukai	— 4

24 x 1 1/4 (32—546)

Araya	— 1
Schwinn S-6 (24 x 1 1/4)	—1
Schwinn S-5 (24 x 1 3/8)	— 4
Ukai	— 1

24 x 1 3/4 (47—521)

Schwinn S-7	— 15

24 x 1.75 (44—507)

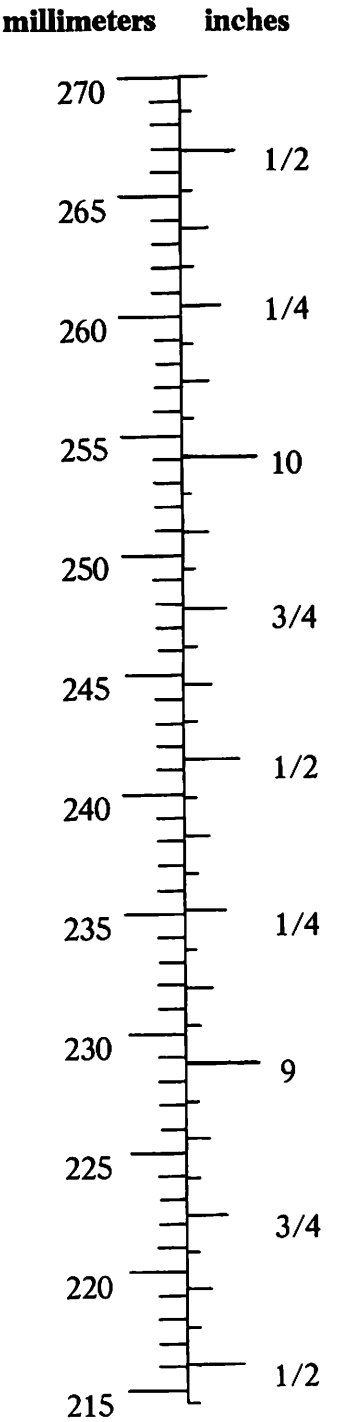
Araya (steel, alloy)	— 21
Sun Metal	— 21
Ukai	— 21

24 x 2.125 (57—507)

Araya (steel, alloy)	— 21
Schwinn S-2	— 22

550A (37—490)

Gitane OEM	— 28
Samir Saminox	— 25



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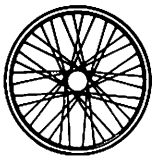


SPOKES, RIMS, TIRES

CHART 4

20" WHEELS

Note: 20 spoke 2X is the same as 40 hole 4X
20 spoke 1X is the same as 40 hole 2X

34 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
36	**223**	**218**	**213**
32	—	**220**	**214**
28	—	**222**	**215**
24	—	—	**214**
20	—	—	**221**

40 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
36	**223**	**216**	**208**
32	—	**219**	**212**
28	—	**222**	**214**
24	—	—	**216**
20	—	—	**220**

44.5 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**220**	**213**	—
36	**223**	**215**	—
32	—	**218**	—
28	—	**222**	—
24	—	—	**215**

48 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**219**	**212**	—
36	**223**	**215**	—
32	—	**218**	—
28	—	**222**	—
24	—	—	**215**

58 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**218**	**210**	**203**
36	**222**	**213**	**204**
32	—	**216**	**206**
28	—	**221**	**209**
24	—	—	**213**

63 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**218**	**209**	**201**
36	**222**	**212**	**203**
32	—	**216**	**205**
28	—	**221**	**208**
24	—	—	**212**

67 mm HUB DIAMETER

no. of spokes	no. of crosses 4X	3X	2X
40	**218**	**208**	**200**
36	**222**	**211**	**201**
32	—	**215**	**203**
28	—	**220**	**207**
24	—	—	**211**

90 mm HUB DIAMETER

no. of spokes	no. of crosses 3X	2X	1X
40	**202**	**191**	**184**
36	**207**	**193**	**184**
32	**212**	**196**	**185**
28	—	**201**	**186**
24	—	**207**	**188**

102.5 mm HUB DIAMETER

no. of spokes	no. of crosses 3X	2X	1X
40	**200**	**187**	**178**
36	**205**	**189**	**179**
32	**212**	**193**	**180**
28	**220**	**198**	**181**
	—	**205**	**183**

CHART 4 20" WHEELS (cont.)

20" and 500A Rim Corrections

20 x 1 3/8 (37—451)

Araya	— 3
Raleigh R 18.0	— 4
Rigida	—3
Schwinn S-5	— 6
Schwinn S-6	— 3
Schurman-Super	— 3
Sturmey Archer EB 18.0	— 4
Ukai	— 3

20 x 1 3/8 (47—419)

Araya	— 20
Schwinn S-7	— 20

20 x 1.75 (44—406)

Araya Steel, hook bead, no dimples	— 26
Araya alloy, hook bead, w/dimples	— 29
Araya alloy, straight side	— 28
M.O. Mfg. Co.	— 28
Rigida	— 26
Sun Metal	— 27
Ukai alloy, hook bead, w/dimples	— 27
Weinmann alloy	— 31

20 x 2 (45—400)

Sturmey Archer FA 16.0	— 26

20 x 2.125 (54—406)

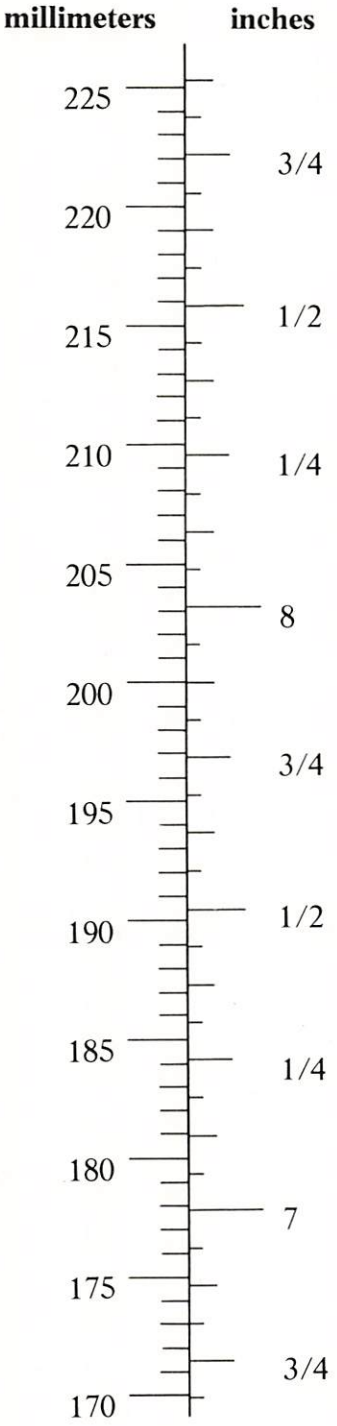
Araya steel, no dimples	— 26
Araya steel, w/dimples	— 28
Femco	— 31
Schwinn	— 27
Kin Lin	— 31

500A (37—440)

Rigida	— 34

20" Sew Ups

Nisi w/rim washers	— 17
San Remo w/o washers	— 19



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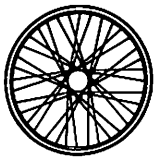


SPOKES, RIMS, TIRES

CHART 5

18" and 16" WHEELS

34mm HUB DIAMETER

no. of spoke	no. of crosses 2X	1X
28	**190**	**186**
24	**193**	**186**
20	**196**	**187**

40mm HUB DIAMETER

no. of spoke	no. of crossés 2X	1X
28	**189**	**183**
24	**192**	**184**
20	**195**	**185**

44.5mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
28	**188**	**181**
24	**191**	**182**
20	**195**	**183**

48mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
28	**187**	**179**
24	**190**	**180**
20	**194**	**182**

58mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
28	**184**	**175**
24	**188**	**176**
20	**194**	**178**

63mm HUB DIAMETER

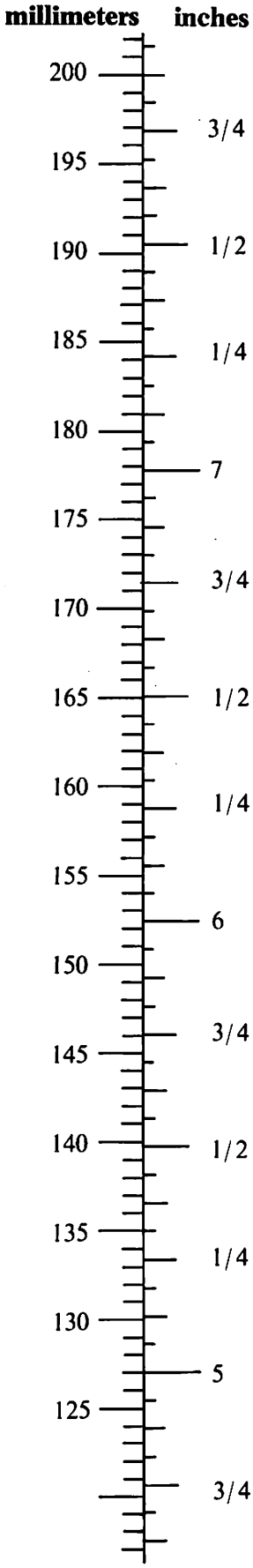
no. of spokes	no. of crosses 2X	1X
28	**183**	**173**
24	**187**	**174**
20	**193**	**176**

67mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
28	**182**	**171**
24	**186**	**173**
20	**193**	**175**

18" and 16" Rim Corrections

18 x 1 3/8	
Araya	— 4
Raleigh	— 4
16 x 1 3/8	
Araya	— 29
Raleigh	— 29
16 x 1.75	
Araya	— 53
Schwinn	—53
Ukai	— 53



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SPOKES, RIMS, TIRES

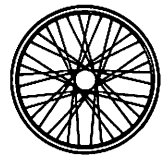


CHART 6
14" WHEELS

34mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**147**	**138**
16	—	**140**

40mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**146**	**136**
16	—	**138**

44.5mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**146**	**134**
16	—	**136**

48mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**145**	**133**
16	—	**135**

58mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**145**	**129**
16	—	**132**

63mm HUB DIAMETER

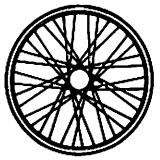
no. of spokes	no. of crosses 2X	1X
20	**145**	**127**
16	—	**131**

67mm HUB DIAMETER

no. of spokes	no. of crosses 2X	1X
20	**144**	**126**
16	—	**130**

14" Rim Corrections

14 x 1 3/8	
Raleigh	— 5
Ukai	— 5



SPOKES, RIMS, TIRES

UNUSUAL WHEELS

48 SPOKE WHEELS

Subtract Rim Correction Factors from these figures.
See page 12-7 for 27" rims, page 12-9 for 26" rims.

no of crosses	rim size 27"	26"
48 mm Hub Diameter		
5 x	**310**	**295**
4 x	**304**	**289**
3 x	**299**	**284**
67 mm Hub Diameter		
5 x	**308**	**293**
4 x	**300**	**285**
3 x	**293**	**278**
90 mm Hub Diameter		
5 x	**307**	**292**
4 x	**295**	**280**
3 x	**285**	**270**
102.5 mm Hub Diameter		
5 x	**306**	**291**
4 x	**293**	**278**
3 x	**281**	**267**

MAXICAR TANDEM HUBS

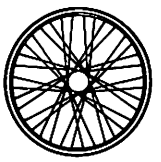
127 mm Hub Diameter
Subtract rim correction factors from these figures.
See page 12-7 for 27" rims, page 12-6 for 26" rims.

27"

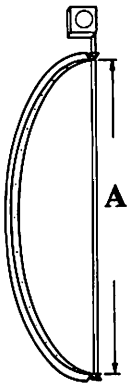
no. of spokes	no. of crosses 4X	3X
48	**290**	**275**
40	**303**	**284**
36	**311**	**290**

26"

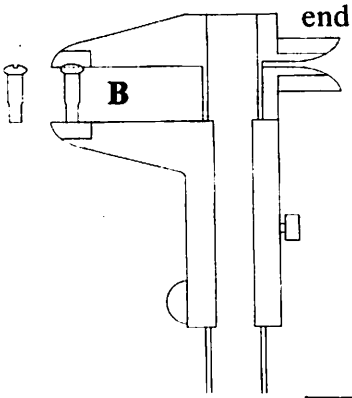
no. of spokes	no. of crosses 4X	3X
48	**275**	**260**
40	**288**	**269**
36	**297**	**275**



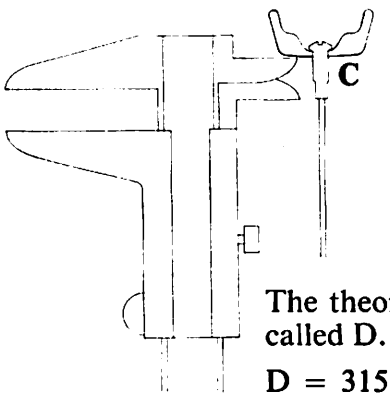
CALCULATING RIM CORRECTION FACTORS



Measure the inside diameter of the rim with a tape measure. To be sure rim is round, measure in several places. This dimension will be called A.



Measure the spoke nipple from the bottom of the slot to the end. This dimension will be called B.



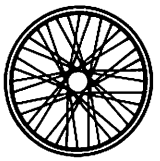
Place a spoke nipple in the rim and measure the part that extends beyond the rim. This dimension will be called C.

The theoretical rim radius the charts are based on will be called D.

D = 315 for 27" rims
300 for 26" rims
270 for 24" rims
225 for 20" rims
200 for 18" and 16" rims
150 for 14" rims

The formula to find the correction factor for a rim not listed on the chart is:

$$\left(\frac{A+2\,(B-C)}{2}\right) - D = \text{Correction Factor}$$



SPOKES, RIMS, TIRES

NUMBER OF SPOKES

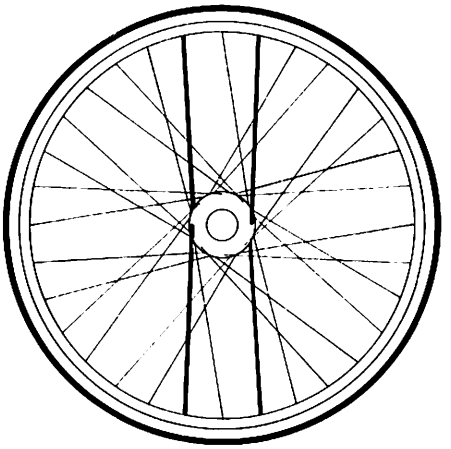


Figure A 32 spokes

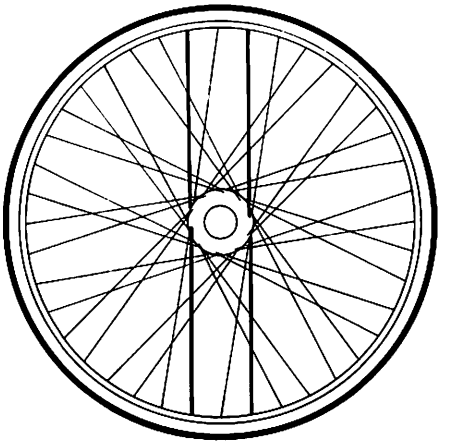


Figure B 40 spokes

ID

32, 36 AND 40 SPOKE WHEELS

32 and 40 spoke wheels have similar spoke patterns as illustrated in figures A and B. With practice they can be easily told apart by looking at the distance between spokes at the rim.

36 spoke wheels have a pattern as illustrated in figure C.

20, 24, AND 28 SPOKE WHEELS

24 spoke wheels have a pattern similar to 32 and 40 spoke wheels.

20 and 28 have a pattern similar to 36 spoke wheels.

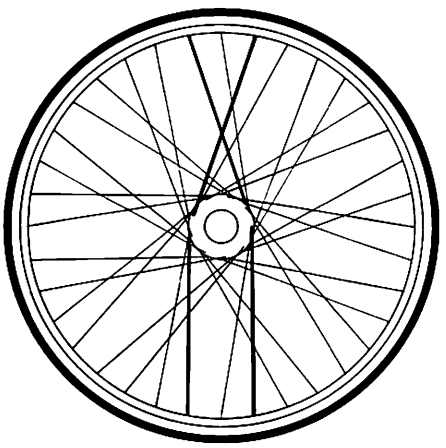
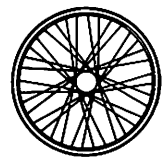


Figure C 36 spokes



Tire and Rim Types

The most common types of tires are *wired-on, hooked bead*[1] and *sew-up*. Both wired-on and hooked bead tires have a wire embedded in the rubber at the inside edge of the sidewall. Hooked bead types have a protruding bead which seats below the hooked edge of the rim to hold the tire more securely in place. These rim cross sections are illustrated in the chart on the following page. Sew-up tires, also known as tubulars or sprints, have the inner tube sewn in. Sew-up rims lack flanges; the tire is held to the dished face of the rim by air pressure and a special adhesive.

Tire and Rim Fit

Type. Each rim type fits only the corresponding tire type.

Width. Tires with an ETRTO[2] Section Width[3] of between 1.45 and 2.00 times the rim width (measured in millimeters between the inside of the flanges) should fit well. Hooked edge rims hold tires with a section width of up to 2.25 times the rim width. Never use an inner tube that is too narrow for tire in which it is installed: it may work at first but it will soon split at the seams.

Diameter. Bead and bead seat diameter are much more important dimensions than outside diameter because they determine tire/rim fit. (Unfortunately, most tires are still marked with the *nominal outside diameter*. Since tires with equal outside diameters may differ slightly in bead diameter they may not fit the same rim.) To insure proper fit, tire bead diameter must be very close to rim bead seat diameter—in general within 1mm. If the tire is too large it will blow off the rim when inflated, if too small the beads will pull down below the bead seat, if the tire can be mounted at all.

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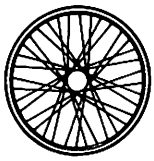
[1] True clincher tires, tires held on by a pronounced bead and a rubber flap under the inner tube, are now obsolete in most parts of the world. Many people still use the term *clincher* to refer to the wired-on and hooked bead tires that have replaced them.

[2] European Tire and Rim Technical Organization.

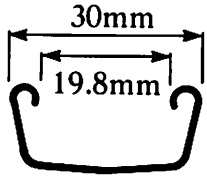
[3] ETRTO Section Width is approximately equal to the distance between the beads measured over the tread in millimeters divided by 2.5. See Measuring Rims and Tires below.



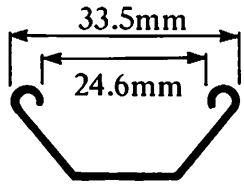
SPOKES, RIMS, TIRES

WIRED ON RIM CROSS SECTIONS

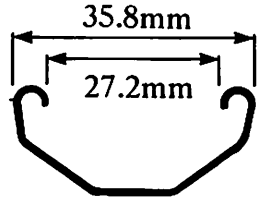
AMERICAN RIMS



"Lightweight"
1.375

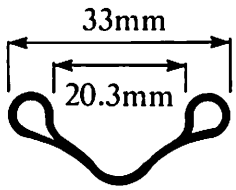


"Middleweight"
1.75

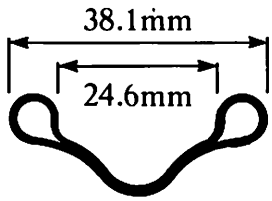


"Balloon"
2.125

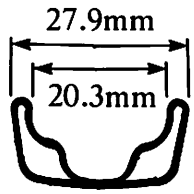
BRITISH RIMS



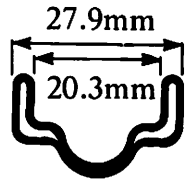
Narrow Westwood
E Type



Westwood
F Type



Endrick
EA Type
(Schwinn S-6 is similar in shape to this type)



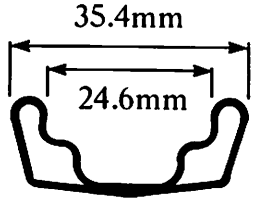
Westrick
R Type
(Schwinn S-5 is similar in shape to this type)

E Type	Narrow Westwood	F Type	Standard Westwood
EA Type	Endrick Pattern	K Type	Special Lightweight
EB Type	Narrow Junior Westwood	R Type	Westrick Raleigh Pattern

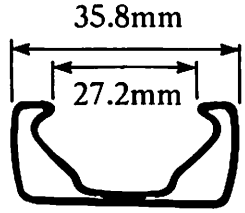
SCHWINN RIMS

Schwinn S-6 see British Endrick

Schwinn S-5 see British Westrick



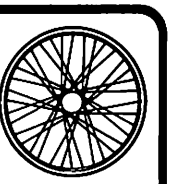
Schwinn S-7
("Middleweight")



Schwinn S-2
("Balloon")

ETRTO, British and French Widths

ETRTO	20	25	28	32	37	40	44	47	50	54	57	62
French	20	25	28	32	35	38	42	45	—	50	54	57
British	¾"	1"	1⅛"	1¼"	1⅜"	1½"	1⅝"	1¾"	—	2"	2⅛"	2¼"



Tire Markings

ETRTO Designations.[3] The ETRTO tire size designations are the only accepted international standard. Many tires carry them in addition to more familiar markings. They consist of two numbers as follows:

37 - 622

ETRTO Section Width in mm — bead diameter in mm

ETRTO markings do not distinguish between wired-on and hooked bead tires.

British. Tires are marked in inches with two or three numbers as follows:

28 × 1⅝ × 1⅜ (ETRTO 37-622)

nominal outside diameter — standard width — actual width

Tires designed for standard rim sizes carry only two numbers:

26 × 1¾ (ETRTO 44-571)

nominal outside diameter — width

26 × 1.75 (ETRTO 44-559)

nominal outside diameter — width

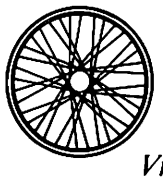
Common fraction in width designation indicates *wired-on* type, *decimal* fraction indicates *hooked bead* type.

Note that 26 × 1¾ and 26 × 1.75 are different type tires and are not be interchangeable.

Schwinn and Canadian. Schwinn tire markings are the same as the British markings described above with the following exceptions (also noted in the tire size chart):

Schwinn	British	ETRTO
26 × 1⅜	26 × 1¼	*32-597*
24 × 1⅜	24 × 1¼	*32-546*

These two Schwinn sizes are *not* interchangeable with the British sizes having identical markings.



SPOKES, RIMS, TIRES

Vredestein-Paragon (Netherlands). Markings are in inches, similar to those of the British system, except that when there are *three* numbers, the last two are *reversed* compared to the British markings. British and Vredestein-Paragon tires in nominal sizes of 24" or less are not interchangeable.

$28 \times 1\frac{3}{8} \times 1\frac{5}{8}$ (ETRTO 37-622)

- 28: nominal outside diameter
- $1\frac{3}{8}$: actual width
- $1\frac{5}{8}$: standard width

French. Markings are in millimeters as follows:

700 × 35 C (ETRTO 37-622)

- 700: nominal outside diameter
- 35: nominal width (sometimes omitted)
- C: code

In the French system, two tires have the same *bead seat diameter* if the first numbers and the final letters match.

Italian, German, Swedish, etc. Many manufacturers mark their tires in inches although actual sizes are often different from true British sizes. Look for an ETRTO designation or measure the tire as described below.

Measuring Rims and Tires

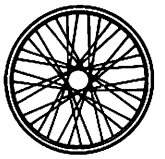
ETRTO measurements are in millimeters. Measure rims and tires as described below.

Rims. Rim *width* is the distance between the inside of the flanges, which can be measured directly. To measure the *bead seat diameter,* first obtain the flange height and the outside flange diameter. The flange height is the distance from the bead seat to the top of the flange. The outside diameter can be measured directly on a bare rim or with a dishing tool. Measure in several places and take an average.

If necessary, the outside flange diameter can be calculated from the rim circumference. Measure the circumference by marking a spot on the rim with a piece of tape and rolling the rim exactly one full turn along a flat surface. The distance of travel is the rim circumference. Calculate the bead seat circumference as follows:

$$\text{rim outside diameter} = \text{rim circumference} \div 3.14$$

$$\text{rim bead seat diameter} = \text{rim outside diameter} - 2 \times \text{flange height}$$



Tires. ETRTO Section Width can be approximated as follows:

$$\text{ETRTO Section Width} = \text{Distance between beads measured over the tread in mm} \div 2.5$$

For proper fit, tire ETRTO Section Width should be between 1.4 and 2.0 times rim width (up to 2.25 times for hooked bead tires and rims).

The most accurate way to determine the bead diameter is to measure a rim that the tire fits. Rim bead seat diameter is usually within 2mm of tire bead diameter. If no such rim is available, use the following technique to measure the bead circumference and calculate the bead diameter. Lay the tire on a flat surface and expand a ¼" wide *flat* steel tape inside the bead. If the tire will not lie flat against the tape, make up a long strip of thin cardboard, using 1" strips taped together, and measure *that*. Calculate the bead diameter as follows:

$$\text{bead diameter} = \text{bead circumference} \div 3.14$$

The results will tend to be low, perhaps as much as 3mm due to the difficulty of holding the tape against the bead.

TIRE SIZE CHART (Headings)

Common Tire Markings (American, English, French, etc.)
If width number is replaced by a dash (—), a range of widths is available in the same bead seat size.

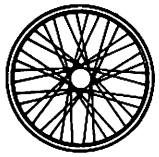
ETRTO Universal Size Designation
Tire section in mm, followed by bead seat diameter in mm. When a range of widths is available, it is shown with the standard width in boldface: 32-340 to **37-340**.

Bead Seat Circumference
3.14 times bead seat diameter.

Brake Radius
Subtract this value from the distance between brake bolt hole and axle center to obtain brake reach.

Rim Outside Diameter (assuming normal flange height)
Actual value for a particular rim may be as much as 5mm less, especially with narrower rims.

Tire Outside Radius
Use this value to calculate tire to fork clearance. Radius of standard width tires is in boldface.



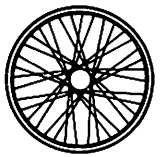
SPOKES, RIMS, TIRES

TIRE and RIM SIZE CHARTS

Gray arrows indicate most of the different tire sizes having similar or identical markings.

Hooked-edge (Decimal), Schwinn, and Canadian	Schwinn rim	British	British rim	French	Italian	Vredestein-Paragon Netherlands (V) BSR on a Vredestein-Paragon tire stands for British Standard Rim Swedish (S), German (G), Standard Unidentified (SU)	ETRTO Width	ETRTO Bead seat diameter	Bead seat circumference	Brake radius	Rim outside diameter	Tire outside radius
		28x1¼	EA2	700		700x32(V)	**32-647**		2032	323	659	358
		28x1⅜	F5 EA4 E4	700A	28x1⅜ 700x35A	28x1⅜(V),(S) 700x35A(V) 28x1½(S) 28x1½x1⅜(S)	**37-642** to 44-642		2016	321	654	**361-** 368
		28x1½	F10 F25.0 EA4	700B	700B 28x1½	28x—x1½(V) 700B(V) 28x1½(G) 28x1⅝(S)	28-635 to **40-635**		1994	317	649	348- **360**
						27x1¼(S)	**32-631**		1982	315	643	350
		27x1¼ 27x1⅛ 27x1	K2 K25.0 EA25.0	27x1¼	27x1¼	27x1¼(G)	20-630 to **30-630**		1978	315	642	338- **348**
						28x1⅝(S)	**44-623**		1958	312	636	359
28x1½ (Canada)		**28x1¾** 28x1⅝	F.13 E7 EA6	700C 28x1⅝x—	700C 28x1¾ 28x1.75	28x—x1¾(V) 28x—x1⅝(V) 28x1.75(V),(G) 28x1¼(G) 28x1⅜(G) 28x1⅝(G)	*20-622 to **47-622**		1955	311	634	334- 361
						27x1½(G) 32x650(G)	**40-609**		1913	304	622	347
27x1½							**40-607**		1906	303	619	346
26x1.375 **26x1.25**							32-599 to **35-599**		1880	300	611	331- **334**

26x1⅜	S-6 S-5	**26x1¼**	E.A.1 E.1 K.1 EA23.5	650		26x1¼(V) 650x32(V)	**32-597** to 37-597	1876	298	609	**333-** 338
		26x1⅜	E.A.3 E.3 F.4 EA23.0 R23.0 E23.0	650A	26x1⅜	26x1⅜(V) 26x1½x1⅜(V) 26x1⅜A(G) 26x1½(G) 650A(V)	**37-590** to 40-590	1854	295	602	**335-** 338
						26x1½(S) **26x1¾** **Transit** (S)	**40-585** to **47-585**	1837	292	600	**335-** **342**
26x1½	S-4	**26x1½** 26x1⅝	F9	650B	26x1½ 26x1⅝	26x—x1½(V),(S) 650B(V) 26x1⅜(G) 26x1⅜x1½(G),(S)	32-584 to **40-584** to 47-584	1835	292	599	327- **335-** 342
26x1¾ 26x1½ (Canada)	S-7	**26x1¾** 26x2x1¾	F.12 F.22.5	650C	26x1¾ 26x1⅝ 650x45C	26x1¾(V) 650x45C(V) 26x2(G)	44-571 to **47-571**	1794	286	586	333- **336**
						26x2.25(S)	**62-561**	1764	281	576	346
26x1.75 **26x2.125**				26x1.75x2 650x50	26x2	26x2.00(V) 650x50(V) 26x1.75(G) 26x2.00(G) 26x2x1¾(G) 650x45(G)	**44-559** to **54-559**	1755	279	573	**321-** 330
24x1.375, 24x1.25										560	316- 313
24x1⅜ 24x1¼	S-5 S-6	**24x1¼**	K.1 EA1,E1			24x1½ beaded (G)	**32-546** to 37-546	1715	273	559	**308-** 313
				600A 24x1⅜x1¼		24x1⅜x1¼(V)	32-541 to **37-541**	1700	271	554	305- **310**
		24x1⅜	E.5 F.3 EA21.0 F21.0 R21.0		24x1⅜ 600x35A	24x1⅜x1½(V) 24x1⅜A(G) 600x35A(V) 24x1½x1⅜(S) 24x1⅜(S)	32-540 to **37-540**	1695	269	552	304- **309**



SPOKES, RIMS, TIRES

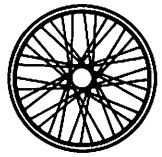
TIRE and RIM SIZE CHARTS

Gray arrows indicate most of the different tire sizes having similar or identical markings.

Hooked-edge (Decimal), Schwinn, and Canadian	Schwinn rim	British	British rim	French	Italian	Vredestein-Paragon Netherlands (V) BSR on a Vredestein-Paragon tire stands for British Standard Rim Swedish (S), German (G), Standard Unidentified (SU)	ETRTO Width	ETRTO Bead seat diameter	Bead seat circumference	Brake radius	Rim outside diameter	Tire outside radius
		24x1½	F8	600B 24x1½		24x1½(V) 600x38B(V)	**40-534**		1676	267	548	310
						24x1½(S) 24x1⅝x1½(S)	**40-531**		1667	265	545	308
24x1¾	S-7	**24x1¾**					***47-521**		1635	260	532	310
						22x1¼(V) 550x32(V)	**32-508**		1595	254	520	289
24x1.75 **24x2.125**				600x45	24x1.75x2	24x2x1¾(V)	**44-507** to **54-507**		1592	253	523	295- 304
						24x2 Transport (S)	**50-503**		1579	251	518	304
		22x1⅜	E.6 F.2 EA19.5		22x1¼ 550x32A		32-501 to **37-501**		1575	250	514	283- 290
						22x1⅜(G) 22x1⅜x1¼(S)	32-498 to **37-498**		1563	249	510	284- **289**
				550A 22x1⅜x1¼		**22x1⅜A**(SU) 22x1¼(G)	32-490 to **37-490**		1539	245	502	280- **285**
					22x1⅜ 550A	**22x1⅜**(V) 550A(V)	32-489 to **37-489**		1535	244	501	279- **284**
				550B		22x1½(G) 22x1⅝x1½(S)	**40-484** to 44-484		1520	242	499	**285-** 289
						22x1½(V) 550B(V)	**40-482**		1515	241	497	284
				550C	22x1¾		***47-470**		1475	235	482	285
22x1.75 **22x2.125**							**44-457** to **57-457**		1435	228	473	**275-** **284**

20x1⅜ 20x1¼	S-5 S-6	**20x1⅜**	E.5J EA18.0 R18.0 EB18.0		20x1¼ 500x35A	20x1⅜BSR(V)	32-451 to **37-451**	1416	225	463	260- **265**
20x1.375, 20x1.25										458	266- 262
				500A 20x1⅜x1¼			**37-440** to 40-440	1382	220	452	**260-** 263
					20x1⅜	**20x1⅜**(V) 500x35A(V)	**37-438**	1375	219	450	259
						20x1½(V) 500x38B(V)	**40-432**	1356	216	446	259
				20x1⅝x1½		**20x2**(S)	40-428 to **54-428**	1345	214	442	257- **271**
20x1¾	S-7	**20x1¾**					***47-419**	1314	209	431	259
20x1.75 **20x2.125**				20x1.75x2 500x50 500x45		20x2x1¾(V) 500x50(V) 20x1.75x2(S) 20x2.00(G)	**44-406** to **54-406**	1274	228	422	**270-** **279**
		18x1⅜ 18x1½ 18x1¾ 20x2	E.4J F.4J		18x1¼ 450x32A	18x1⅜BSR(V) 20x2x1¾(S)	**37-400** to 54-400	1257	200	412	**240-** 257
				450A 18x1⅜x1¼			**37-390** to 40-390	1225	195	403	**235-** 238
					18x1⅜	**18x1⅜**(V) 450x38A(V)	**37-387**	1216	193	400	233
						18x1½(V) 450x38B(V)	**40-381**	1196	190	395	233
						16x1¼(SU)	**32-369**	1169	184	382	219
						17x1¼(S)	**32-357**	1122	179	371	214
18x1.75 **18x2.125**				450x45		18x2x1¾(V) 18x1.75(G) 18x2(G)	**44-355** to **54-355**	1115	177	371	219- 228
		16x1⅜	E.3J EA14.0 EB14.0		16x1¼ 400x32A		32-349 to **37-349**	1097	174	362	209- 214

SUTHERLAND'S HANDBOOK FOR BICYCLE MECHANICS



SPOKES, RIMS, TIRES

TIRE and RIM SIZE CHARTS

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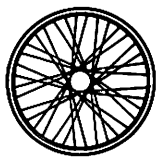
Hooked-edge (Decimal), Schwinn, and Canadian	Schwinn rim	British	British rim	French	Italian	Vredestein-Paragon Netherlands (V) BSR on a Vredestein-Paragon tire stands for British Standard Rim Swedish (S), German (G), Standard Unidentified (SU)	ETRTO Width / Bead seat diameter	Bead seat circumference	Brake radius	Rim outside diameter	Tire outside radius
				400A 16x1⅜x1¼			32-340 to **37-340** to 44-340	1069	170	353	205- **210-** 217
					16x1⅜	**16x1⅜**(V) 400x35A(V)	**37-339**	1065	169	352	209
						16x1⅜A(SU)	**37-337**	1058	168	350	208
						16x1½(V) 400x38B(V)	**40-330**	1036	165	344	208
16x1¾	S-7	**16x1¾**					**44-317**	996	158	329	205
16x1.75 **16x2.125**						16x2x1¾(V) 16x2(V) 16x1.75x2(S)	**44-305** to **57-305**	957	152	321	**194-** **203**
		14x1⅜	E.2J F.2J EA11.7		14x1¼ 350x32A 14x1⅝	14x1⅜BSR(V) 14x1⅜(S)	32-298 to **37-298**	937	149	310	184- **189**
				350A 14x1⅜x1¼			32-288 to **37-288** to 44-288	904	144	300	179- **184-** 191
					14x1⅜	**14x1⅜**(V) 350x35A(V)	**37-286**	897	143	298	183
					14x1½	**14x1½**(V) 350x38B(V)	**40-279**	877	139	294	182
14x1.75 **14x2.125**							**44-253** to **57-253**	795	126	269	**168-** **177**

		12x1⅜			12x1⅜ 12x1¼ 300x32A 12x1⅝		32-248 to **37-248**	779	123	260	158- **163**
				300A 12x1⅜x1¼			32-239 **37-239** to 57-239	751	119	251	154- **159-** 179
						12x1⅜(V) 300x35A(V)	**37-235**	738	117	247	157
						12x1½(V) 300x38B(V)	**40-229**	718	114	243	157
					11x1¾	**11x1¾**(V)	**47-222**	698	111	229	161
		12½x2¼		320x57 12½x2¼	12½x1.75	**12½x2¼**(V),(S)	**62-203**	638	101	217	166
					10x1¼	10x1⅝(SU)	32-194 to **44-194**	609	97	209	132
						8x1¼(G)	**32-135**	425	67	148	102
						8½x2(V)	**54-110**	346	56	126	113
						7x1¾(G)	**47-93**	292	47	108	97

*Indicates tubular tire size rim diameter.

TIRE INFLATION

PSI: Pounds per square inch
ATM: Atmospheres (Bar, Atü)
Kg/Cm²: Kilograms per square centimeter



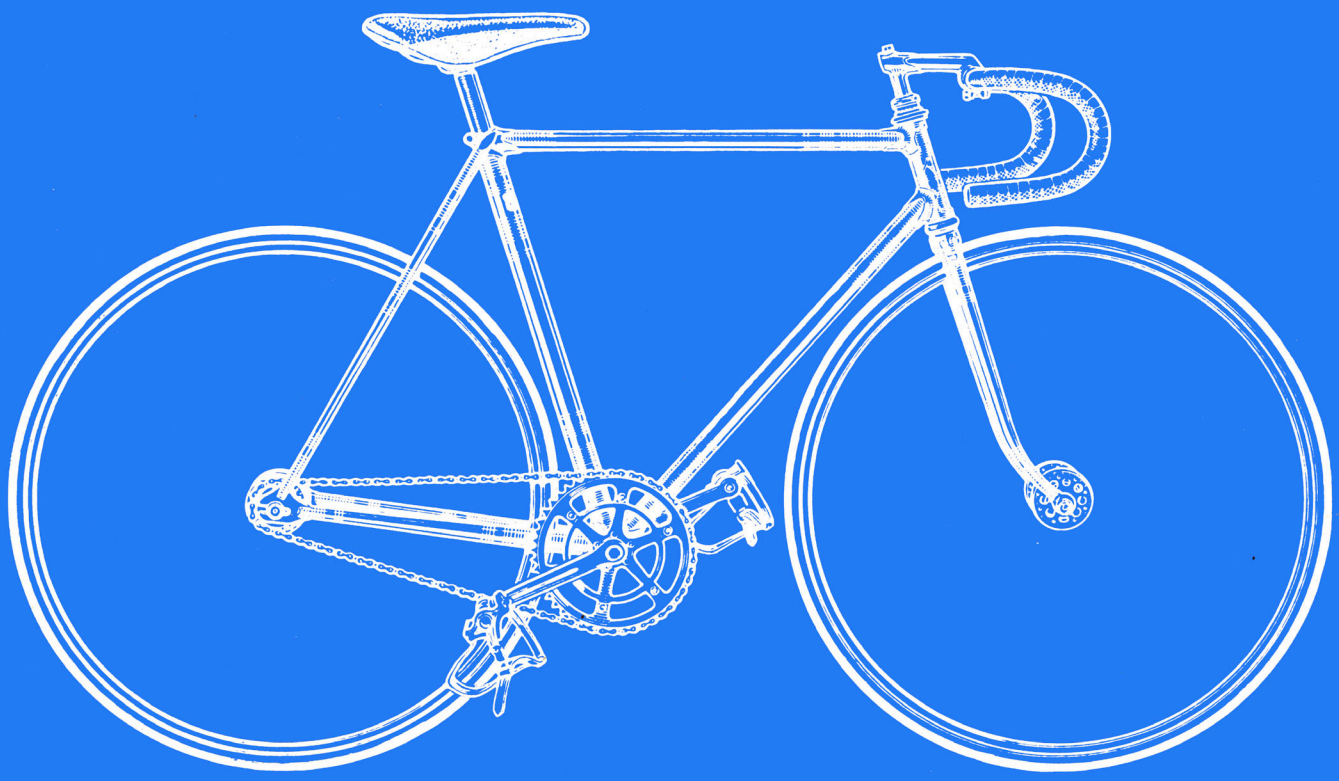
SPOKES, RIMS, TIRES

VALVE HOLE SIZES

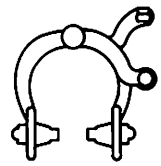
Presta	6.8mm
Dunlop (Woods)	8.3mm
Schrader	9.0mm

— NOTES —

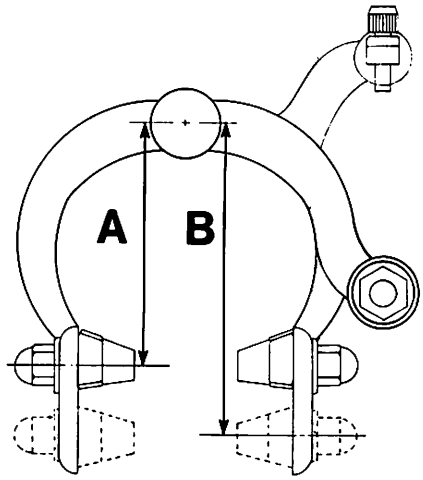
Caliper Brakes



BRAKES



BRAKE DIMENSIONS — SIDE PULL

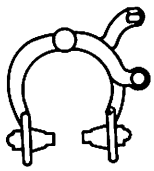


When fitting a new brake try to fit one close to the center point of the slot. Fitting a brake at highest or lowest limits may cause problems as pads wear in. All measures taken with new brake blocks set approximately 25mm apart.

	Center of Slot	A	B
Campagnolo* regular	52	48	56
piccolo (short arm)	47	43	51
Cherry			
1450	59	50	68
1480	67	55	79
1400	70	61	79
1300	78	69	87
1130	84	75	93
1140	96	87	105
CLB Pro	50	45	55
Dia Compe			
Gran Compe	50	45,47	55,57
500, 500G	50	43	57
730, 730G	62	52	72
810, 810G	70	61	79
890**	78	68	88
1020**	85.5	74	93
1080**	96	84	108
Galli 75 and Ti	50	45	55
Mafac			
LS	50	44	57
LS2	50	44	56
LC	52	45	60
Lam			
Lam 49-72	60.5	49	72
Lam 59-77	68	59	77
Lam 66-86	76	66	86

*Campagnolo rear brake can be lowered 6mm by using Brake center bolt No. 2012/2.

**Made for use with balloon and middle weight wheels.



BRAKES

BRAKE DIMENSIONS — SIDE PULL (cont.)

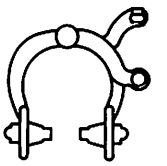
	Center of slot	A	B
Shimano			
Dura-Ace CS-49	44	39	49
CS-57	52	47	57
600	50	43	57
Tourney CS-72	60	54	72
CS-79	70	61	79
CS-82	79	70	88
SunTour Superbe			
regular	53	47	57
small	45	40	50
Universal***			
Model "CX" N.97	40.5	39	42
Model "CX" N.98	52	46	59
Model "77" N.99/B	45	40	50
Model "77" N.99/N	48	42	54
Model "125" N.125	51	46	56
(Sport) #131 small	53	44	62
#133 large	64	56	72
Extra (51) #100 small	50.5	45	56
#101 large	64	56	72
Super 68 #102 small	47.5	41	54
#103 large	56.5	50	63
Weinmann****			
Carrera, 605	53	46	60
500	50	43	57
730 (Schwinn LS 2.4)	62	53	71
810** (Schwinn LS 2.8)	70	61	79
890** (Schwinn MS 3.1)	78	69	87
1020** (Schwinn MS 3.3)	83.5	74.5	92.5
1080** (Schwinn BS 3.6)	96	84.5	108

** Made for use with balloon and middleweight wheels.

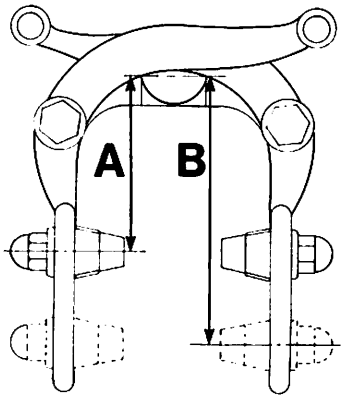
*** Universal makes a wide variety of brakes. Models listed are the standard ones. There are extra long and extra short models. When in doubt, measure.

**** Weinmann has several lines with the same dimensions; model 506 for instance has the same dimension as 500. Model 733 the same as 730, etc.

BRAKES

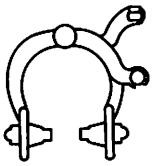


BRAKE DIMENSIONS — CENTER PULL



	Center of Slot	A	B
Alfa			
Super Alfa	54	48	60
Super Alfa 71	50	44	56
Centric	63	56	70
CLB Racer* old style	63	55	71
New style	59	48	70
Dia Compe			
610	54	47	61
750	66	57	75
810	70	61	79
Mafac			
Racer			
small	56	48.5	63
large	61	53.5	68
w/adjustable mounting slot	65	55.5	75
2000			
small	55.5	48	63
large	60.5	53	68
w/adjustable mounting slot	65	55	75
Competition			
small	49	44	54
large	54	49	59
w/adjustable mounting	58.5	51	66
S			
small	56.5	49	64
large	61.5	54	69
w/adjustable mounting slot	66	56	76
Raid	72.5	65	80
GT			
small	48	43	53
large	53	48	58

*Old style has threaded brake pivot bolt; New style—arms cannot be removed.



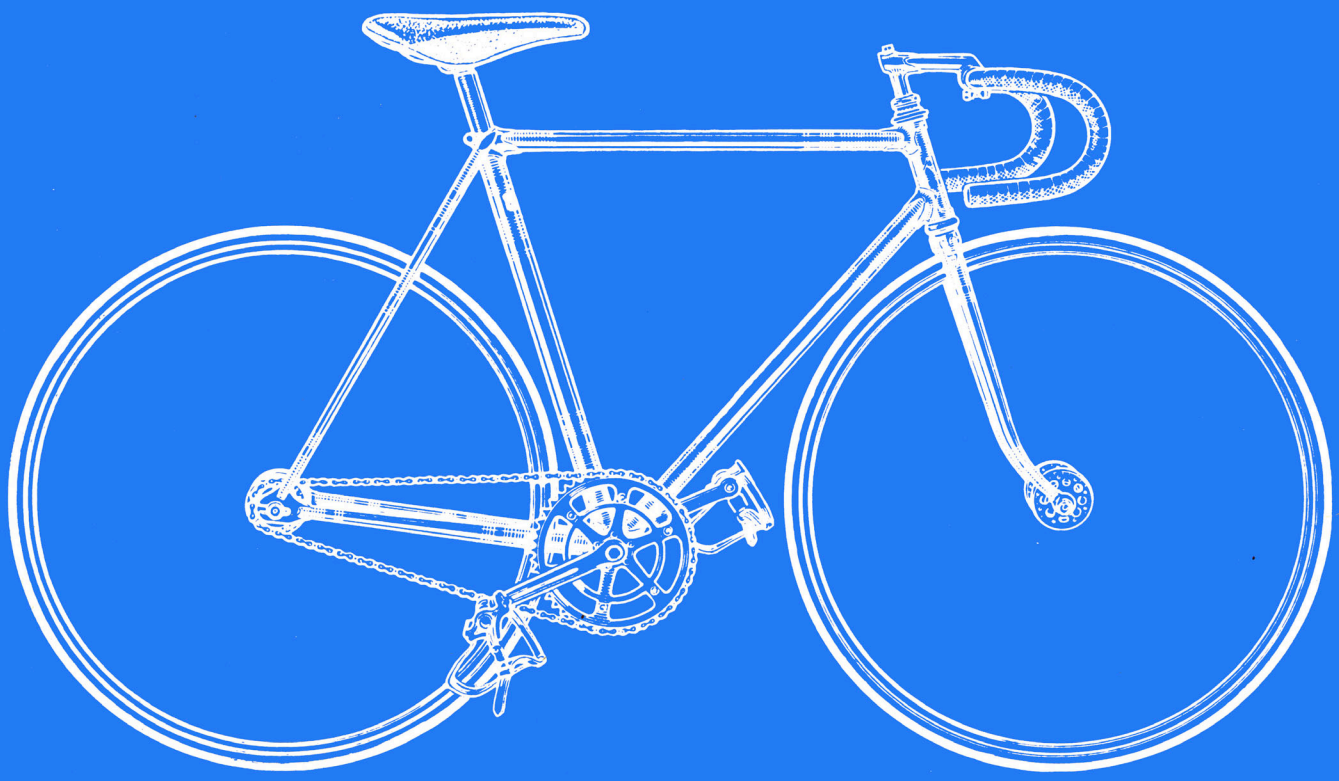
BRAKES

BRAKE DIMENSIONS — CENTER PULL (cont.)

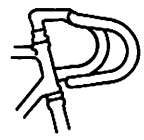
	Center of slot	A	B
Shimano			
600 and Tourney CC-62	54.5	47	62
Tourney CC-65	56	47	65
600 and Tourney CC-75	66	47	75
Universal*			
Model 61 #105 small	55.5	49	60
#106 large	64	56	72
(Sport) #108 small	55.5	49	60
#109 large	64	56	72
Weinmann			
610 (Schwinn LC 2.3)	56	50	62
750 (Schwinn LC 2.7)	67	59	76
Zeus 2000	49	45	53

*Universal makes a wide variety of brakes. Models listed are the standard ones. There are extra long and extra short models. When in doubt, measure.

Headsets, Stems, Handlebars



HEADSETS, STEMS, HANDLEBARS



THREAD SIZES

Standard

Austrian*	26mm x 1.0mm	(1.023" x 25.4 TPI)
English**	1" x 24 TPI	(25.4mm x 1.058mm)
French	25mmx1.0mm	(.984"x25.4TPI)
Italian	25.4mmx24TPI	(1"x1.058mm)
Raleigh***	1"x26 TPI	(25.4mmx.977mm)
USA	1"x24 TPI	(25.4mmx1.058mm)

* Top quality bikes use English

** Includes Dunelt and Phillips prior to 1963. After 1963 see Raleigh.

*** Raleigh, Rudge, Humber, and brands made by Raleigh after 1963. Except bikes made by Carlton, which use 1 x 24 TPI.

A Raleigh with a 71 or 76mm bottom bracket shell generally use 26 TPI on the headset as well as the bottom bracket. Raleigh with a 67 or 68mm bottom bracket shell use 24 TPI in both headset and bottom bracket.

ID A check with a thread pitch gauge will separate the French from the English and Italian headsets and forks.

English and Italian steering columns have the same diameter and number of threads per inch. The thread profile, however, is different. See section on measuring threads, page 0-3.

Juvenile

Most juvenile bikes use standard headset threading. Some, however, use the following:

English	7/8" x 24 TPI	(22.2mm x 1.058mm)
French	23mm x 1.0mm	(0.905" x 25.4mm)
Italian	22.2mmx24TPI	(7/8" x 1.058mm)

Tandems

Many tandems use standard headsets. Some, however, use 28 mm x 1.0mm. Older English tandems used 1 1/8"x26TPI which was also used on motorcycles.

Other

Some older English headsets (Chater Lea) were 31/32x30TPI.

HEADSETS, STEMS, HANDLEBARS

ID MARKINGS ON THREADED HEADSET PARTS

Campagnolo, Dura Ace, Tange Levin and others mark headsets as follows:

English	1''x24 TPI	ENGLAND
French	25x1.00	FRANCE
Italian	25.4x24 F	ITALY

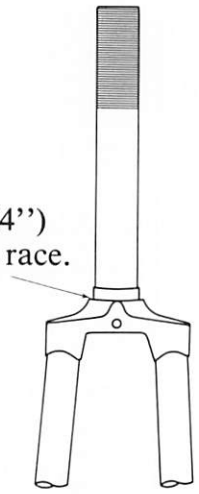
Stronglight S5

English	25.4x1.058
French	25x1

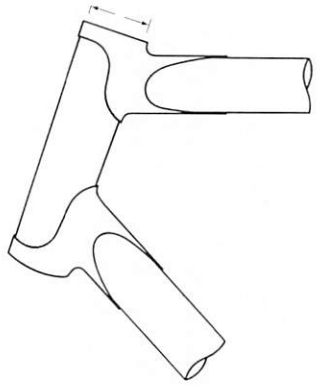
Zeus

English	BSC
French	no mark

Crown race seat should be 0.1mm (.004'') larger than the crown race.



Inside head tube should be 0.2mm (.008'') smaller than the pressed race.

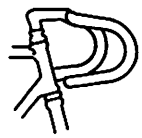


HEADSET PRESS FIT DIMENSIONS

These are the dimensions that tend to turn up in manufacturers catalogs. They vary from the charts in this book and are frequently different from measured parts.

	crown race inside diameter	upper and lower pressed race outside diameter
Austrian	26.7	30.8
English	26.5, 27.0	30.0
French	26.5, 27.0	30.2
Italian	26.5, 27.0	30.2
Japan Industrial Standard (JIS)	27.0	30.0
Campagnolo style	26.4	30.2
BMX	26.4	32.7

HEADSETS, STEMS, HANDLEBARS



HEADSET BINDING—CAUSES

1. Bent fork, head tube or steering column
2. Improperly milled head tube and/or crown race
3. Poorly fitting parts
4. Worn or damaged parts
5. Dirt, chips or other contamination
6. Cross threaded, crooked, or wrong threads
7. Poor adjustment
8. Too many balls
9. Wrong size balls
10. No lubrication
11. Poor quality headset—some aren't meant to work

REPLACING STACKS

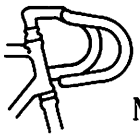
The "fit" of a headset is so complicated that an exact replacement unit should be used unless there is a very good reason for using a different type. In most worn-out headsets, only the lower races are impaired. The chances of running into problems during replacement are minimized if only the "lower stack" is replaced. The top stack usually outlasts the lower stack by 2 to 1 (or more).

Replacing the lower stack — points to check

1. Total height of the replacement stack
2. Crown race inside diameter should be 0.1mm (.004") smaller than crown race seat. Be sure to note if crown race has a shoulder that will prevent it from seating properly.
3. Lower pressed race diameters should be 0.2mm (.008") larger than inside head tube. Milled portion of inside head tube must be deep enough.

Replacing top stack — points to check

1. Threads of screwed race and locknut must match threads of steering column.
2. Total height of replacement stack. Don't forget center pull brake hanger thickness.
3. Upper pressed race diameter should be 0.2mm (.008") over inside head tube diameter. Milled portion inside head tube must be deep enough.
4. Lock washer or brake hanger diameter and locking device must be compatible with grooves or flats in steering column and also with column diameter.
5. Stem must fit in hole in top lock nut.



HEADSET, STEM, HANDLEBARS

MIXING PARTS WITHIN STACKS

There is a risk of incompatibility when mixing headset parts, and the practice should be avoided when possible. However, with care, mixing parts can work. Use the following factors to catch problems early in the job.

1. Are parts of a similar design? For example, you can't replace a Peugeot screwed race with a Campagnolo screwed race.
2. Are mating parts designed to use the same size and number of balls?
3. Do the parts nest properly? Most headsets are designed so that the cups and cones overlap slightly to help keep dirt out.
4. Will the centerpull brake hanger fit properly? Some will not seat properly without washers or different parts.

Try it. Before installing a mixed headset, try it out off the bike (or half off the bike if it's easier). First put the cup and cone pieces together without the balls to make sure that they nest. Then try the fit again with balls. Under pressure the parts should rotate smoothly on each other; and although they can rock slightly, they should not feel unstable. This also gives you a chance to check the stack heights.

If possible, avoid mixing a high and low quality race in one bearing since performance and reliability will be limited by the low quality part. Using one high quality stack (both races) in a low quality headset can give greatly improved performance, especially if the lower, more heavily loaded stack is the good one.

INCORRECT STEERER LENGTH

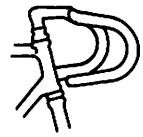
Steerer too short (Top locknut must engage at least 3 full turns on good threads).

1. Remove any extra locknuts or spacers (be sure brake hanger still clears headset).
2. Find a headset with shorter stacks.
3. If the bicycle was assembled correctly in the first place and the fork isn't absolutely too short, enough metal can be milled from top and bottom of the head tube to accommodate a thicker headset. (For example, Campagnolo Strada). Milling the frame is time consuming but preferable to stripping the end of the steerer.
4. Change to side pull brakes that don't require brake cable hanger.

Steerer too long

1. Add extra lockwasher.
2. Cut or file shorter.
3. Use a taller locknut.

HEADSET, STEM, HANDLEBARS



TIPS AND PROBLEMS TO AVOID

Before cutting or filing the steerer, run a screwed race on below where you intend to cut. When you are finished, you can unscrew the race to clean up the threads.

Mounting a Japanese headset on a European bike frequently results in having a stem that will not fit through the hole in the locknut. Use the old locknut or ream the new nut and protect bare steel from rust.

Whenever a headset is disassembled, it is a good practice to replace all the balls. Headset balls carry the load and road shocks without rolling and are therefore likely to become deformed.

Putting a Campagnolo headset in a bike designed for another headset frequently results in a too-short steerer. One solution is to mount a Campagnolo track headset. Another is to mill the upper and lower head lugs by a distance equal to the difference in thicknesses. Using either method, the frame will remain level and the steering geometry won't be changed.

Lockwashers should just fit over the steerer. If the hole is too large, the locking tang or flat will tend to rotate and damage the threads. Avoid the temptation to use an English or Italian lockwasher on a French bike. The flat can be filed to do the job of a tang. Don't file the lockwasher round. It must have a tang or flat to do its job. You can simply use the old washer.

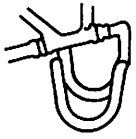
The parabolic cup and cone design of most headsets allows the bearing to function even with a slightly crooked steerer, steerer thread, or mis-milled frame or fork. Headsets with cones which are truly conical or which have u-shaped or v-shaped races require more critical alignment if the races are going to contact all the balls without having tight spots.

When mounting FT headsets or Stronglight V-4, or others of this type, it is important to mill the head tube and crown race seat to ensure the best performance from these designs.

➡ If the frame is straight and the original headset binds, it is more likely due to imprecision in milling the frame than the original imprecision of the headset. Changing headsets without milling the head tubes and fork crown is not recommended.

On some frames, usually less expensive French and some Japanese, the ends of the head tube are milled slightly concave. This is to give better support to the pressed races of an inexpensive headset. If you plan to change to a more expensive headset, the head tube should be milled flat to match the new headset. Good head sets are usually thicker than cheap ones, so milling the head lug will also prevent the steering column from being too short.

SUTHERLAND'S HANDBOOK FOR BICYCLE MECHANICS

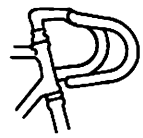


HEADSETS, STEMS, HANDLEBARS

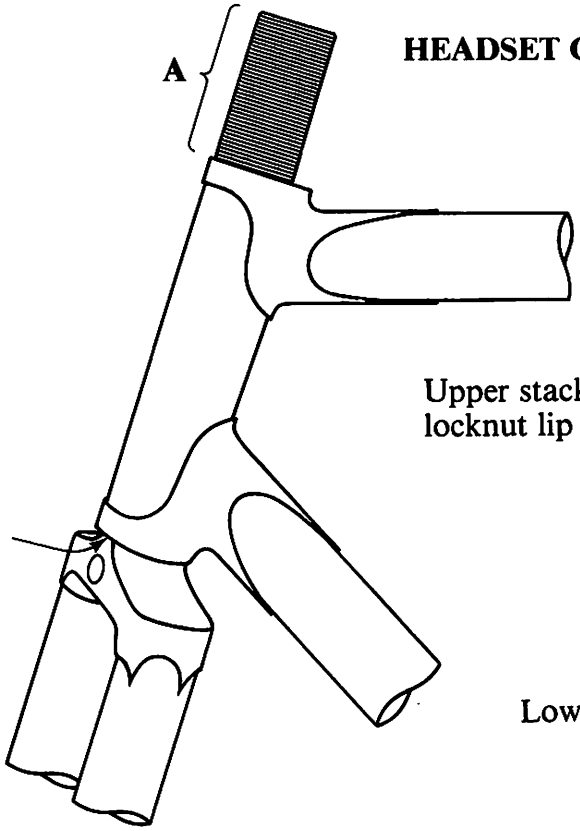
HEADSET DIMENSIONS CHART

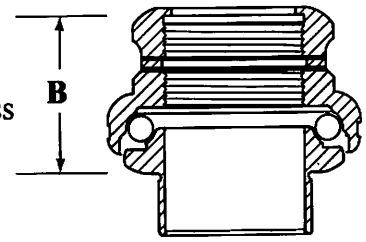
thread	A	B	C	D	E	F	G	H	J	K	L	M	N	O
Beacon- French French Replacement	31.2	21.3	9.9	7.4	22.9	32F	3.9	flat	44.2 ϕ	29.8-30.3	27.0	4.8	25 5/32	26 5/32
Bianchi- Italian Uraces	46.7	29.7	17	9	22.5	32.2ϕ	2.0	tang	32ϕ	30.1	27.0	9.9	31 1/8	31 1/8
Campagnolo all Record Strada	39.1	24.6	14.5	5.7	22.5	32.0F	2.1	tang[1]	32F	30.2[2]	26.3[3]	9.9	22 3/16	22 3/16
Campagnolo all Record Pista	33.7	22.3	11.4	5.7	22.5	32.0F	2.1	tang[1]	32F	30.2[2]	26.4[3]	7.0	25 5/32	25 5/32
Crown 2276 Raleigh	30.4	18.5	11.9	8.1	22.4	33F	not included		42ϕ	30.1	26.9	8.2	27 5/32	26 5/32
Murray English Universal[3]	40.1	28.2	11.9	13.0	21.4	30.0F	2.0	tang	43ϕ	34.2	25.6	5.7- 8.6	26[4] 5/32	26[4] 5/32
Nishiki English 63-01-020[5]	44.9	33.5	11.4	9.0 3.0	21.6	34F 35.ϕ	3.8 3.1	tang	46.7ϕ	30.1	27.0	7.5	26 5/32	26 5/32
Nishiki English 63-01-017[5]	41.5	30.4	11.1	8.5 3.0	21.5	35.0F 35.ϕ	4.0 3.1	tang	46.0ϕ	30.1	27.0	7.1	26 5/32	26 5/32
Nishiki English 63-01-015[5]	40.8	29.7	11.4	11.2 3.0	21.6	30.0F 35.ϕ	1.6 3.1	tang	46.4ϕ	30.1	27.0	7.0	26 5/32	26 5/32
Nishiki English 63-01-010	38.1	26.7	11.4	11.2	21.6	30.0F 35.ϕ	1.6 3.1	tang	46.4ϕ	30.1	27.0	7.0	26 5/32	26 5/32
Nylfor English French	32.7[6] 32.2[6]	21.6[6] 21.2[6]	11.1 11.0	9.0 8.0	22.8 22.5	31.7F 31.7			43.7F 44.0F	30.1 30.15	26.5 26.9	8.1 7.0 max	25 25 5/32	26 26 5/32

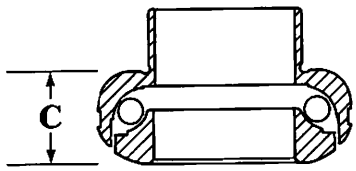
HEADSETS, STEMS, HANDLEBARS



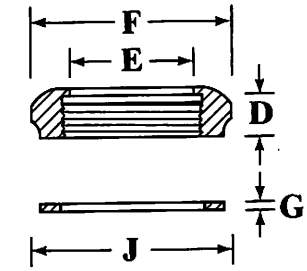
HEADSET CHART KEY

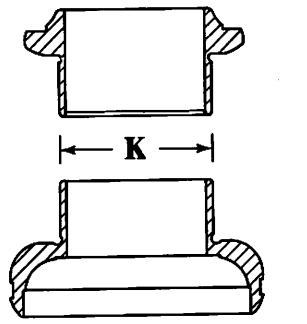


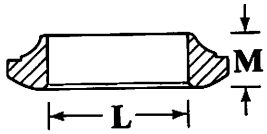




➡ With the fork crown race seat against the bottom of the head tube the length of steerer tube protruding from the top should be about 2mm less than A.

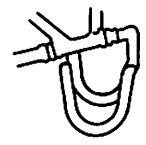






A upper and lower stack height minus locknut lip thickness
B upper stack height minus locknut lip thickness
C lower stack height
D locknut height minus lip thickness
E locknut stem hole
F locknut flat dimension F indicates flat ϕ indicates diameter with pin-holes in side
G washer thickness (over teeth if any)
H washer locking method
J screwed race dimension F indicates flat ϕ indicates diameter with pin-holes or notches
K upper and lower press race diameter
L crown race seat diameter
M crown race seat depth
N upper race ball size and number
O lower race ball size and number

SUTHERLAND'S HANDBOOK FOR BICYCLE MECHANICS



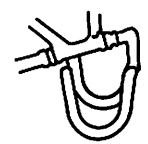
HEADSETS, STEMS, HANDLEBARS

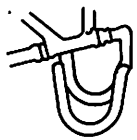
HEADSET DIMENSIONS CHART (cont.)

Make	Thread	A	B	C	D	E	F	G	H	J	K	L	M	N	O
OF ME GA	Italian	39.6	28.4	11.2	10.3	22.7	32F	2.0	tang	32.1F	30.1	27.0	6.2	26 5/32	26 5/32
(Competizione)	Italian	40.9	26.2	14.7	7.4	22.5	32F	2.2	tang	32.0F	30.2	26.4	9.1	22 3/16	22 3/16
(inexpensive)	Italian	38.8	27.0	11.8	8.9	22.7	32F	1.3	tang	32.3F	30.2	26.9	3.3-6.6	26 5/32	26 5/32
Peugeot OME	French	38.5	26.5	12.0	10.8	22.4	32F	2.5	long tang	45.7ϕ	30.1	26.5	7.0	26 5/32	26 5/32
Raleigh Rat 101	Raleigh	37.0	23.7	13.3	8.2	22.9	30.2F	2.7		41.3F	30.3	27.0	6.1	25 5/32	25 5/32
Raleigh Pat 803	English (whit.)	41.1	28.1	13.0	12.8	22.9	30.4F	2.7		41.2F	30.0	27.0	6.0	25 5/32	25 5/32
Raleigh Aletet	English	36.1	24.6	11.5	7.3	22.5	30.6F	3.3		42.0F	30.0	26.9	6.7	26 5/32	26 5/32
Schwinn Delux	English	36.7	26.4	10.3	10.9	21.3	0.2F	2.0	tang	41.2ϕ	32.6	26.5	5.6	26 5/32	22 3/16
Schwinn Standard	English	36.9	26.9	10.0	10.9	21.3	0.2F	2.0	tang	45.3ϕ	32.6	26.4	3.2-5.8	22 3/16	22 3/16
Schwinn Approved (imported Schwinn)	English	41.8	30.6	11.2	11.1 3.1	21.2	30.0F 35ϕ 3 notch	1.9	tang	44.8ϕ	30.1	26.4	6.9	26 5/32	26 5/32
Shimano Dura Ace	all	39.7	24.7	15.0	5.4	22.4	32F	2.1	tang'	32.0F	30.3	26.3	9.6	22 3/16	22 3/16
Shimano Le Tour	English	42.5	31.5	11.0	10.9 3.9	21.2	30F 35ϕ 3 notch	1.9	tang	44.8ϕ	30.0	26.4	6.6	26 5/32	26 5/32

Make	Thread	A	B	C	D	E	F	G	H	J	K	L	M	N	O
Steyr (Puch) 81716 OEM	Austrian	35.4	24.8	10.6	11.9	22.2	30F	3.0	tang	46.5ϕ	31.0	26.7	6.7	5/32	5/32
Stronglight V4	English	39.3	25.3	14	7.5	22.5	31.6F	4.9	flat	45.3ϕ	30.3	27.0	5.2 max	26 5/32	26 5/32
	French	39.5	25.6	13.9	7.5	22.5	31.8F	5.3	flat	45.2ϕ	30.2	26.9	4.6 max	26 5/32	26 5/32
Stronglight P3	English	34.0	22.9	11.1	6.4	22.4	28.3F	4.5	flat	45.0ϕ	30.3	26.8	5.2 max	26 5/32	26 5/32
	French	34.0	22.9	11.1	6.4	22.1	30.0F	4.5	flat	45.1ϕ	30.2	26.9	5.2 max	26 5/32	26 5/32
Stronglight S5	English	40.6	26.8	13.8	7.1	22.5	31.7F	2.7		31.8F	30.2	27.0	7.5	26 5/32	26 5/32
Tange Levin	English	37.8	25.7	12.1	6.7	22.3	32.0F	2.1	tang	32	30.2	26.3 26.9	7.6	26 5/32	26 5/32
WHW	French	39.1	27.7	11.4	8.6	22.2	35.2F	4.84	tang	44.6ϕ	30.1	26.9	2.3-7.2	26 5/32	26 5/32
Zeus	French	40.7	25.8	14.9	6.4	22.4	32.0F	2.0	flat	32F	30.2	26.2	9.1	22 3/16	22 3/16

1 French has flat
2 also available 0.5mm oversize
3 also available 0.5mm undersize
4 uses retainer #73
5 has 2 locknuts and 2 washers
6 less washer
7 pressed races not identical
8 pressed races identical



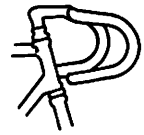


HEADSET, STEM, HANDLEBARS

HEADSET DIMENSION NOTES

Make	Thread	A	B	C	D	E	F	G	H	J	K	L	M	N	O

HEADSET, STEM, HANDLEBARS



STEMS—STEERING COLUMNS

STEM DIAMETER

Imported Bicycles

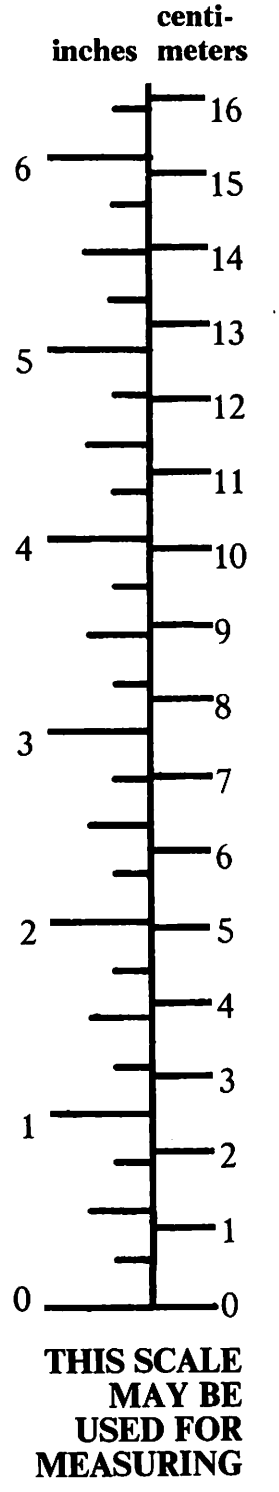
➡ These figures can serve only as a rough guide.

Stem diameter	Used in the following countries*
22.2mm (7/8")	England, Belgium, Italy, Japan (see 21.15 also)
22mm	Germany, Austria, Denmark, Switzerland
21.9mm	France, Spain
21.15mm (.833")	Japan (on many bicycles for US market)

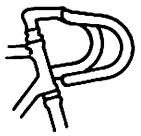
*Countries not listed generally use national standards listed on pg. 0-4.

USA bicycles (Including Schwinn)
Before 1966 —7/8" (22.2mm)
1966 and after—.833" (21.15mm) Frequently listed as 13/16" although it is actually .020" (0.50mm) larger than 13/16".

— NOTES —



THIS SCALE MAY BE USED FOR MEASURING



HEADSET, STEM, HANDLEBARS

HANDLEBARS — STEMS

HANDLEBAR DIAMETERS

22.2 and 23.8mm (approx. 7/8" and approx. 15/16"). Both sizes are used in most countries. Bicycles made in U.S.A. with steel bars most often use 22.2mm. Cinelli bars are 24.2mm. Many Cinelli style copies are 24mm.

HANDLEBAR CENTER DIAMETERS

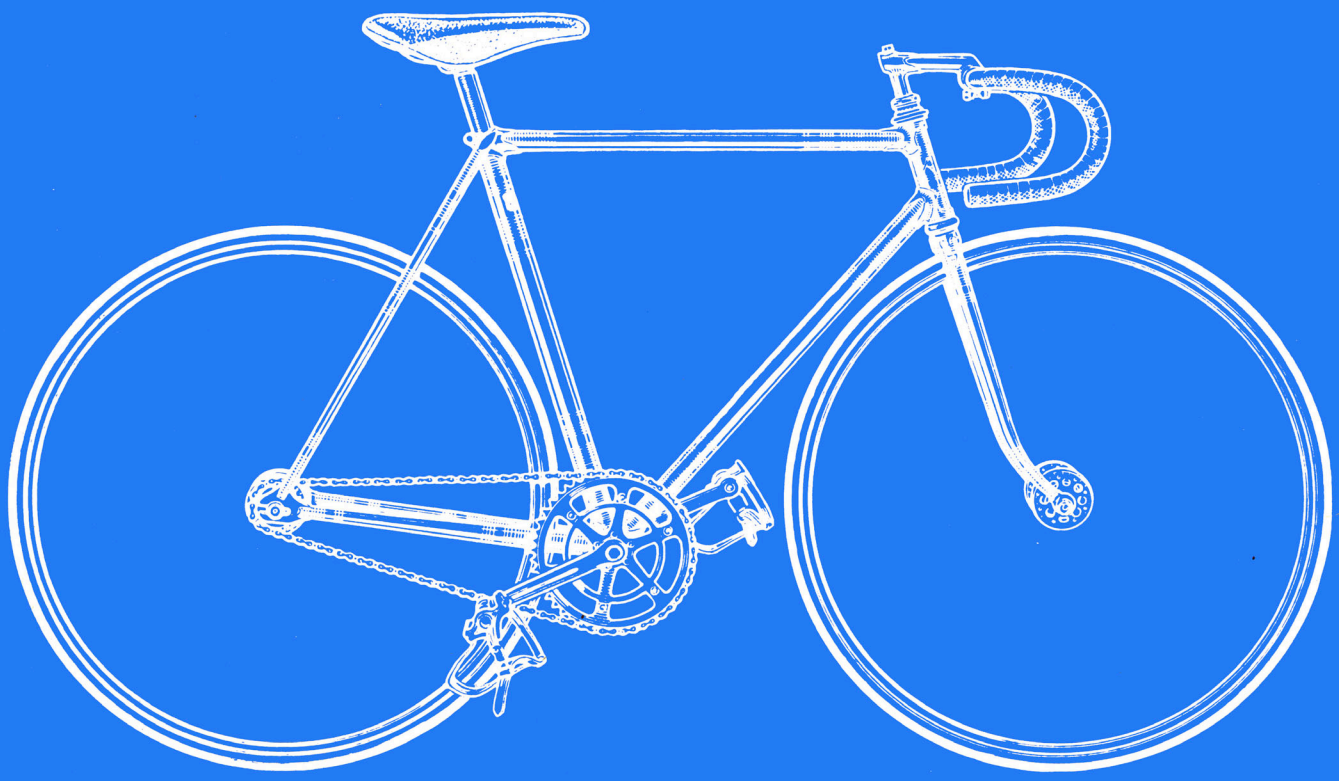
➡ These figures can serve only as a rough guide. No hard and fast rules can be made.

English	25.4, 23.8 (1", 15/16")	Generally 23.8 is found on 3 speed and coaster brake bikes.
French	25.0, 23.8	
Italian	25.0, 23.8	Exceptions: Cinelli—26.4 TTT-26
Japan	25.4	Exceptions: Cinelli copies 26.4
USA	25.4	Exception: Schwinn used 15/16" on Randonneur bars in 1971.

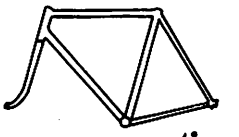
Other exceptions: Titan makes 27mm and 25mm centers. The 27mm center fits only Titan stems.

— NOTES —

Frame Tubes
Fork Ends
Seat Posts



FRAME TUBES, FORK ENDS



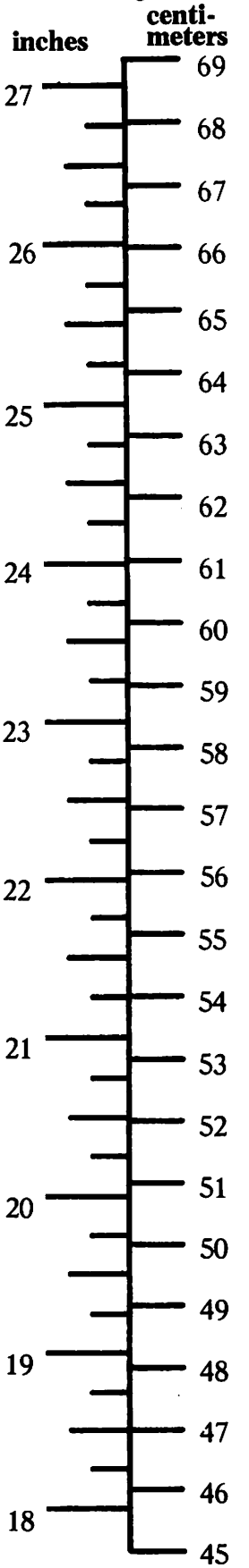
TUBING—OUTSIDE DIAMETERS

Frame member	English	French	Italian	USA
Top Tube	25.4mm	26mm	25.4mm	22.2mm
Down Tube	28.6	28	28.6	25.4
Seat Tube	28.6	28	28.6	25.4
Head Tube	31.75	32	31.75*	Varies
Steering Column	25.4	25	25.4	25.4
Mixte Tubes	13 or 14	13 or 14	13 or 14	——

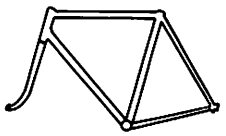
*Bianchi with special Bianchi headset uses 30mm head tube.

Chain Stay, Seat Stay, and Fork Blade dimensions vary between tubing manufacturers and it is difficult to make generalizations.

— NOTES —



NOT INTENDED FOR MEASURING COMPARATIVE SCALE ONLY



FRAME TUBES, FORK ENDS

GEAR HANGERS

THREAD SIZES

French 10mm x 1mm

Italian 10mm x 26 TPI

Forkend gear hangers are most often French threaded.

French, Spanish, and Japanese Equipment is all French threaded.

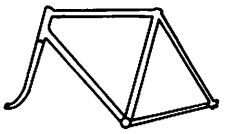
Damage to the threads of both the Gear hanger bolt and the fork ends occur when threading a 10mm x 1mm gear hanger bolt into a 10mm x 26 TPI hole and vise versa. The damage is slight however because 26 TPI is very close to 1 thread per millimeter or 25.4 TPI. Running a tap of the correct size through the fork end will minimize the damage.

FORK END THREADS

	Gear hanger Threads	Rear Tip Adjusters	Mud Guard Eyes
Campagnolo	10mm x 26 TPI	3mm x 0.5mm	5mm x 0.8mm
Huret	10mm x 1.0mm	3mm x 0.6mm	4mm hole with no threads tapped easily to 5mm x 0.8mm
Shimano	10mm x 1.0mm	3mm x 0.5mm	5mm x 0.8mm
Simplex	9mm hole with no threads tapped easily to 10mm x 1.0mm	3mm x 0.5mm	5.0mm hole with no threads
Sun Tour	10mm x 1.0mm	3mm x 0.5mm	5mm x 0.8mm
Zeus	10mm x 1.0mm	3mm x 0.5mm	5mm x 0.8mm

FRAME TUBES, FORK ENDS

REPLACING FORKS



➡ Viscount and Lambert aluminum forks break without warning and should be replaced with steel forks.

The main problem in replacing a fork is that the original is often damaged in such a way that it is difficult to determine its characteristics.

Factors That Affect Handling

Rake. The rake of the fork should approximate that of the old. Small changes in rake will quicken (less rake) or slow (more rake) the handling slightly. Larger changes will generally make the bike uncomfortable to ride since the relationship between head angle and fork rake will be disturbed.

Length. The length of the fork—measured from the crown race seat to the axle—should also be the same. If the new fork is shorter than the old, the head of the frame will be lower and the effective head angle will be increased. The reverse is true if a longer fork is used. As with a change in rake, a change in head angle affects the handling of the bike. Small changes are less likely to be unpleasant than large ones.

If you have to change one, change both. Using a repair fork with less length and less rake will often give a faster handling but still balanced bicycle. Using a fork with more length and more rake results in slower bike handling.

Rigidity. Unlike other frame members the fork is not triangulated. It functions as a beam. The fork receives stresses from the wheel and either transmits them to the frame or dissipates them by flexing. (Rigidity is sideways as well as fore-aft). A replacement fork should match the original in construction and materials unless a change in ride is desired.

Factors That Affect Fit

Wheel. The forkends should be the same distance apart as the hub locknuts so the wheel can be installed and removed easily.

The slots in the forkend should be approximately the same width as the diameter of the hub axle so that the axle can fit into the slot yet locate accurately. The forkends should be thick enough for the quick release to clamp them firmly. If necessary, the ends of the axle can be filed or ground slightly shorter so that the quick release can be adjusted close enough to clamp tight on the forkends.

Frame. The steerer must be enough longer than the headtube to allow the headset to be fitted. See table in headset section.

Threads. If the steerer needs to be cut to length, enough threads must remain after cutting to allow the headset to be installed. The steerer can, of course, be tapped to increase the length of the threaded portion. See section on thread cutting, pages 0-8, 0-9, and 0-17.

Stem. Steerer inner diameter must correspond with stem diameter. There are three common sizes of stem, and each requires a different steerer bore. The fit between stem and steerer should be a close sliding fit; there should be no wobble between stem and steerer. See stem diameters page 14-11.

It is not safe to shorten the stem to install it in a steerer which does not allow it to enter at least 2''.

Brake Fit. This can be estimated by subtracting the rim center line radius from the distance from the axle center line to the brake hole.

If this measurement is well within range (see the tire size chart) the brake will fit. If this measurement indicates that the brake shoes will be at or near (within 2mm) the limit of the travel, the wheel and brake should be tried on the fork before proceeding.

Headset Fit. See headsets.

SEAT POSTS

SEAT POST SIZES

Tubing inside diameters vary so much from maker to maker that no size listed can be considered correct until actually tried in the bicycle.

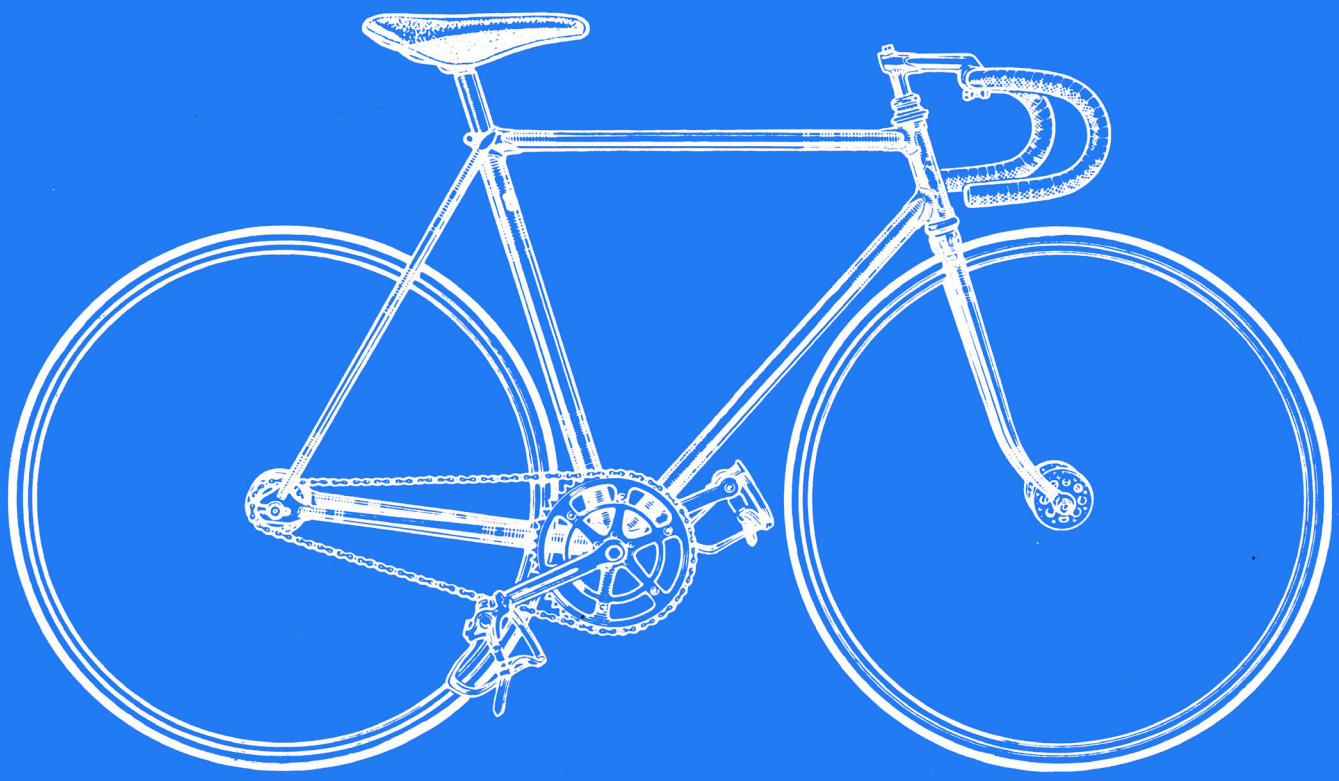
	Common Tubing	Quality Tubing	
		Plain Gauge	Butted
English	1" (25.4) 1 1/64" (25.8) 1 1/32" (26.2)	26.4 26.6	27.0 27.2
French	25.0 25.5 25.8 26.0	26.2	26.4 26.6
Italian	25.0 25.8 26	26.0 26.2	26.8 27 27.2
Japan	25.8 (1 1/64) 26.2 (1 1/32)	26.2 26.8	26.4 26.6 26.8 27.0
USA	.833" (21.15)*	See English	

*Frequently listed as 13/16".

BMX SEAT POST SIZES

Frame tubing	Size
Regular	.833" (21.15mm)
Cro Mo	.875" (22.2mm)
Alloy (Aluminum)	.810" (20.5mm)
Cook Bros.	.890" (22.6mm)

Appendix



APPENDIX

ABBREVIATIONS

A	British Standard Coarse when stamped on French parts
B.S.C.	British Standard Coarse
D	Right handed thread when stamped on French, Italian or Spanish parts.
F	Thread, when stamped on Italian parts
F.F.	French threads, when stamped on Italian parts
F.I.	English threads, when stamped on Italian parts
G	Left handed thread when stamped on French parts
I	Left handed thread, when stamped on Spanish parts
L	Left handed thread, when stamped on English parts
LH	Left Hand
M	Metric
OEM	Original Equipment Manufacturer
R	Right handed thread, when stamped on English parts
RH	Right hand
S	Left handed thread when stamped on Italian parts
TPI	Threads per inch

The following books are recommended:

Delong's Guide to Bicycles and Bicycling—the Art and Science, Fred Delong 1974,1978 $9.95
Chilton Book Co.
Sales Service Department
Chilton Way
Radnor, PA 19089

Bicycling Science—Ergonomics and Mechanics, $5.95
Frank R. Whitt and David Wilson 1974
MIT Press
28 Carleton St.
Cambridge, MA 02142

Bicycles and Tricycles—An Elementary Treatise on Their Design and Construction, Archibald Sharp 1896
MIT Press
28 Carleton St.
Cambridge, MA 02142

* APPENDIX

WIRE GAUGE COMPARISON CHART

English Gauge No.	British Standard Wire Gauge (SWG) mm/inches		French Wire Gauge No (Jauge de Paris)	mm/inches		Birmingham Wire Gauge mm/inches	
27	0.41	0.016	P	0.5	.020	.41	0.016
26	0.46	0.018	1	0.6	.024	.46	0.018
25	0.51	0.020	2	0.7	.028	.51	0.020
24	0.56	0.022	3	0.8	.031	.56	0.022
23	0.61	0.024	4	0.9	.035	.61	0.024
22	0.71	0.028	5	1.0	.039	.71	0.028
21	0.81	0.032	6	1.1	.043	.81	0.032
20	0.91	0.036	7	1.2	.047	.91	0.036
19	1.02	0.040	8	1.3	.051	1.02	0.040
18	1.22	0.048	9	1.4	.055	1.22	0.048
17	1.42	0.056	10	1.5	.059	1.42	0.056
16	1.63	0.064	11	1.6	.063	1.63	0.064
15	1.83	0.072	12	1.8	.071	1.83	0.072
14	2.03	0.080	13	2.0	.079	2.11	0.083
13	2.34	0.092	14	2.2	.087	2.41	0.095
12	2.64	0.104	15	2.4	.095	2.77	0.109
11	2.95	0.116	16	2.7	.106	3.05	0.120
10	3.25	0.128	17	3.0	.118	3.40	0.134

SPOKE SIZES

Note the underlined sizes in the chart above. They are a source of a lot of confusion. English gauge numbers get smaller as wire gets larger. French gauge numbers get larger as wire gets larger. The gauge numbers cross about where cycle spokes are.

GEAR RATIO FORMULAS

ENGLISH

$$\frac{\text{Diameter of tire in inches} \times \text{number of teeth on front chainwheel}}{\text{number of teeth on rear sprocket}}$$

Cycle gears are given in "inches". This dates to the time of the "Ordinary" or "Pennyfarthing" Bicycle and refers to the diameter of the big wheel. In the present chain driven bicycle the term "inches" is still used but it now refers to the size of an "Ordinary" wheel which would be required to move the same distance forward for one pedal revolution. To calculate the distance travelled for one revolution of the pedals, multiply the gear in inches by pi, i.e. 3.14.

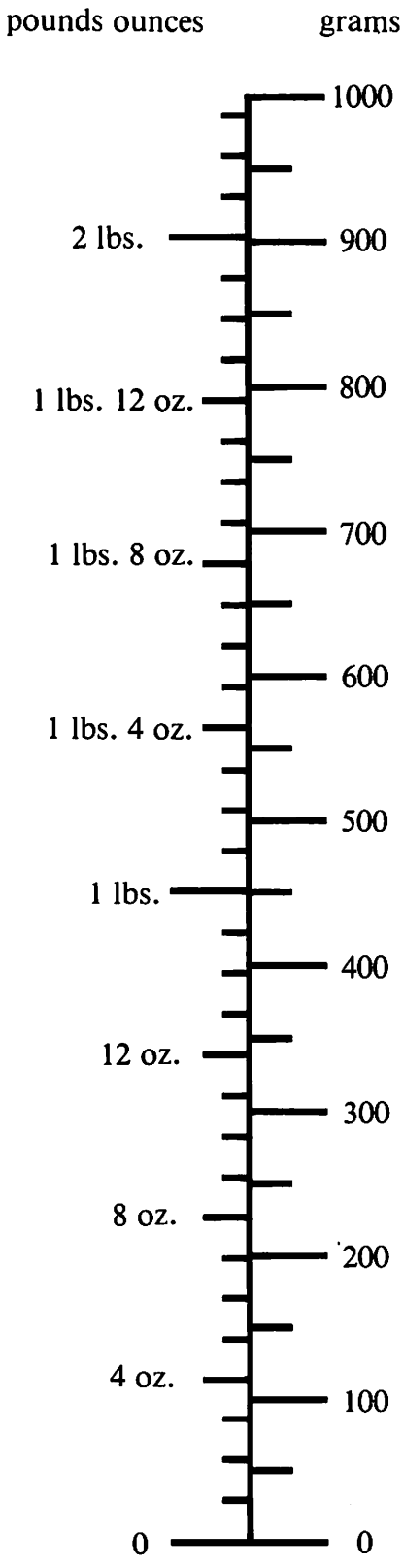
From Raleigh Catalog, England.

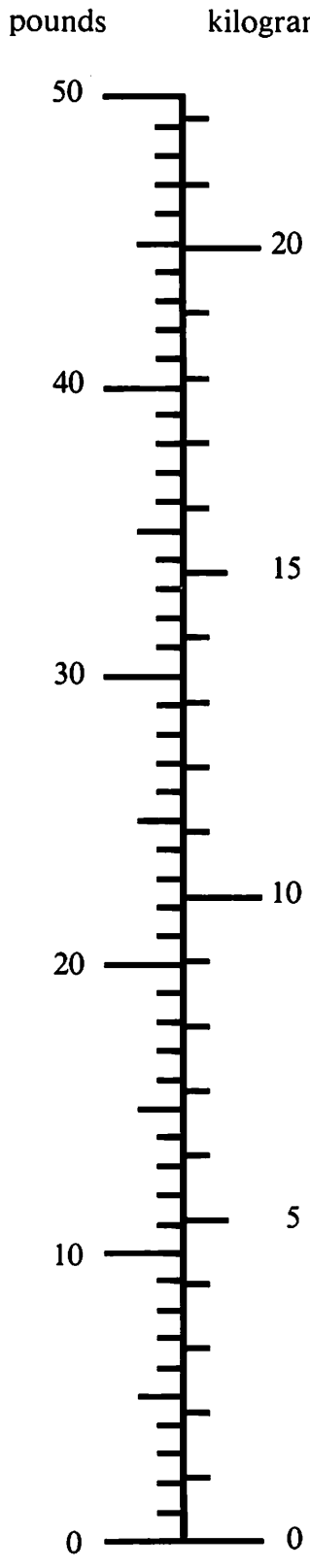
METRIC

$$\frac{\text{Diameter of tire in meters} \times 3.14\ (\text{pi}) \times \text{number of teeth on front chainwheel}}{\text{number of teeth on rear sprocket}}$$

The metric gear ratio formula gives you the number of meters traveled per pedal revolution.

WEIGHT CONVERSIONS





* APPENDIX

TAP DRILL SIZES

METRICS SIZES

Thread Size	Nearest U.S. Tap Drill Size	Metric Tap Drill Size
5.0mm x 0.8mm	#19	4.20mm
6.0mm x 1.0mm	#9	5mm
10mm x 1.0mm	"T"	9mm

AMERICAN SIZES

Thread Size	U.S. Tap Drill Size
6-32	#37
8-32	#29
10-32	5/32
10-24	#27
1/4-20	#7

SPOKE LENGTH FORMULA

$$L = \left(\sqrt{r_1^2 + r_2^2 + w^2 - 2r_1 r_2 \cos x}\right) - \tfrac{1}{2}y$$

where:

L = spoke length

r_1 = rim radius (to end of spoke position)

r_2 = ½ hub diameter measured to spoke hole centers

w = ½ hub width

$$x = \frac{360^0}{\tfrac{1}{2}\text{ (number of holes in hub)}} \quad \text{x number of crosses}$$

y = diameter of spoke hole in hub

Take this page to your local quick printer and run off enough for several months worth of bicycle assemblies.

ASSEMBLY CHECK LIST — WORK NOT DONE FEEDBACK SHEET

Make_____ Model_____ Box #_____

Frame Size Mens Ladies_____ Color_____

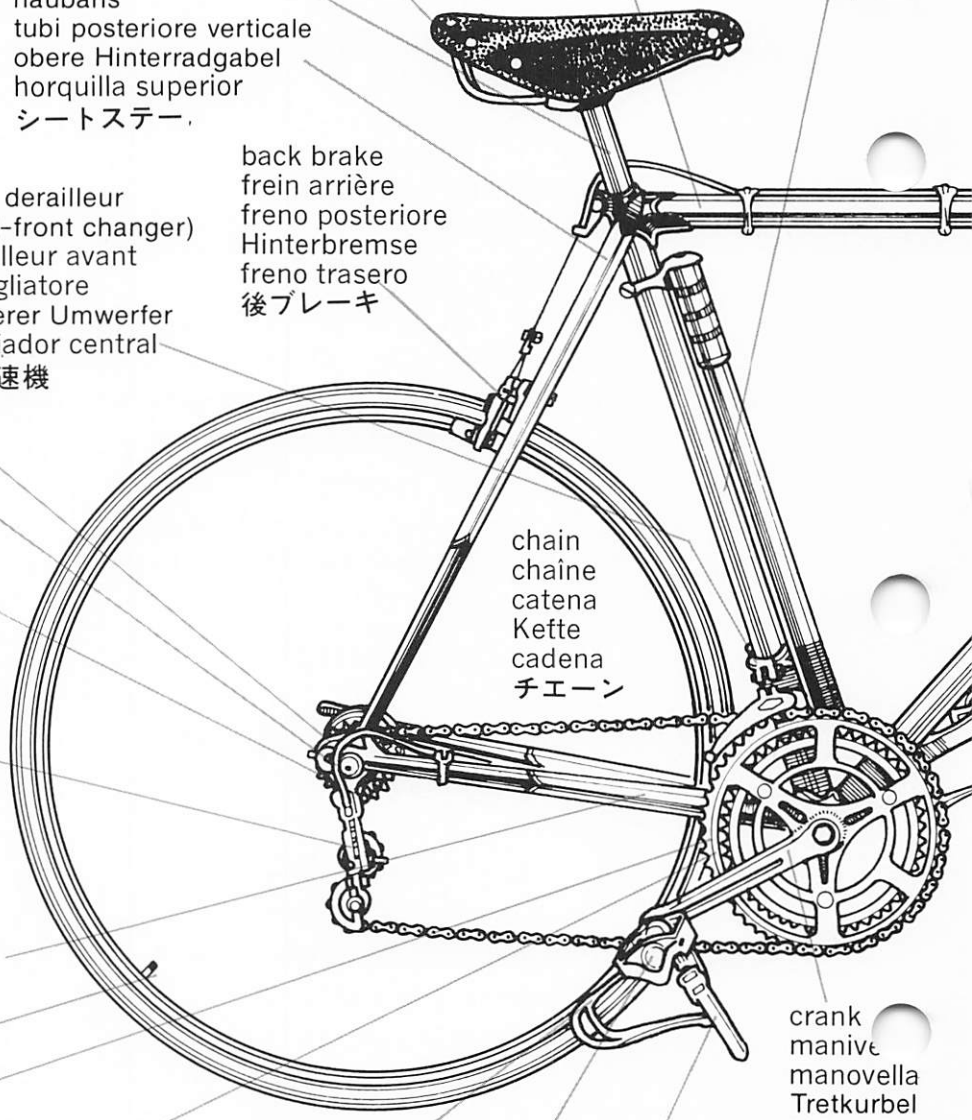
Time Started_____

- ☐ brake cables greased
- ☐ derailleur cables greased
- ☐ stem greased
- ☐ seat post greased
- ☐ seat binder bolt greased
- ☐ saddle clamp binder bolt greased
- ☐ handlebar binder bolt greased
- ☐ stem bolt tightened
- ☐ seat post bolt tightened with brake hanger in correct positions
- ☐ seat level
- ☐ seat clamp bolt tight
- ☐ shift lever tight
- ☐ cable stops and guides tight
- ☐ pedal threads oiled
- ☐ pedals attached and tight
- ☐ derailleur hanger bolt tight
- ☐ drop outs parallel
- ☐ fender attaching bolts tight
- ☐ freewheel threads greased
- ☐ wheel bearings adjusted
- ☐ wheels centered
- ☐ axle nuts or quick releases tight
- ☐ reflectors installed
- ☐ brake lever bolts tight
- ☐ rubber lever covers
- ☐ caliper mounting bolt tight
- ☐ caliper pivot bolts tight or adjusted
- ☐ customer brake adjustment screwed all the way down
- ☐ brake pads adjusted and tight
- ☐ brakes toed in
- ☐ brake cables stressed to handle bar
- ☐ head set adjusted
- ☐ chainwheel bolts tight
- ☐ bottom bracket adjusted
- ☐ cotters or crank bolts tight
- ☐ chainwheels true
- ☐ derailleurs adjusted
- ☐ front derailleur 1/16" over teeth
- ☐ excess grease wiped off
- ☐ toe clips and straps installed
- ☐ kickstand tight
- ☐ put in easy gear to ride
- ☐ air in tires
- ☐ valve caps on
- ☐ warranty card filled in with date assembled and your initials

Time finished_____

Total Time_____

BICYCLE PARTS GUIDE



seat post (GB-seat pin, seat pillar)
tige de selle
cannotto reggisella
Sattelstütze
tija del sillin
シートピン (シートピラー)

seat (GB-saddle)
selle
sella
Sattel
sillín
サドル

top tube
tube horizontal
tubo orizzontale
Oberrohr
tubo superior
トップチューブ

seat tube
tube de selle
tubo verticale
Sattelrohr
tubo del sillín
シートチュ

rear dropout, rear fork tip
patte arrière
forcellino
hinteres Ausfallende
pata de cuadro
後ツメ (後ドロップアウト)

seat stays
haubans
tubi posteriore verticale
obere Hinterradgabel
horquilla superior
シートステー

back brake
frein arrière
freno posteriore
Hinterbremse
freno trasero
後ブレーキ

front derailleur
(GB-front changer)
dérailleur avant
deragliatore
vorderer Umwerfer
desviador central
前変速機

gear cable
câble de dérailleur
cavo per cambio
Schaltungskabel
cable del cambio
ギヤケーブル

freewheel or block
roue libre
ruota libera
Freilauf
rueda libre
フリーホイル

chain
chaîne
catena
Kette
cadena
チエーン

rear derailleur (GB-rear changer)
dérailleur arrière
cambio
hinterer Umwerfer
cambio de marchas
後変速機

chainstays
bases
tubi posteriore orizzontale
untere Hinterradgabel
horquilla inferior
チエーンステー

crank
manive
manovella
Tretkurbel
biela
クランク

valve
valve
valvola
Ventil
válvula
バルブ

chainrings
plateaux
ingranaggi
Kettenräder
platos
チエーンリング

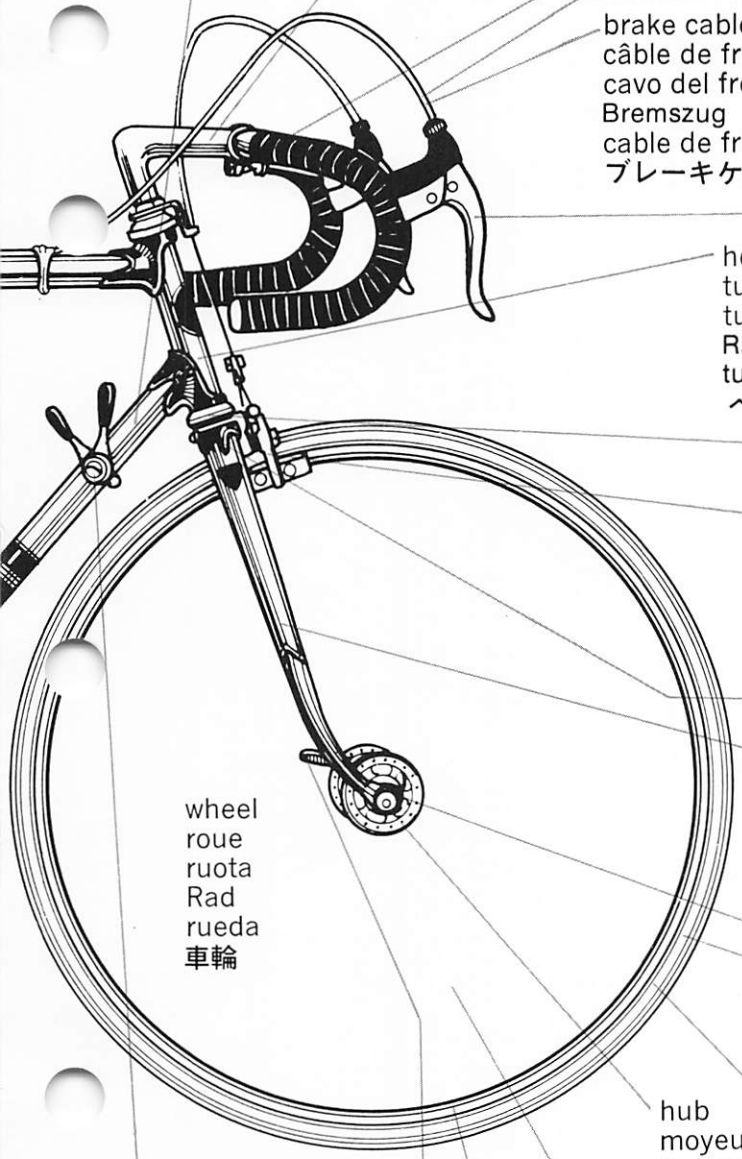
crankset
jeu de pédalier
guarnitura
Tretlager-Garnitur
movimento centrale
ギヤ板

toeclip
câle-pied
fermapiede
Pedalhaken
calapie
トークリップ

toestrap
courroie
cinghietta
Pedalriemen
correa del calapie
トーストラップ

pedal
pédale
pedale
Pedale
pedal
ペダル

bottom bracket
boîte de pédalier
serie movimento
Tretlager
caja de pedalier
ハンガー



bicycle —English
bicyclette, velo —French
bicicletta —Italian
Fahrrad —German
bicicleta —Spanish
自転車 —Japanese

down tube
tube diagonal
tubo obliquo
Unterrohr
tubo inferior
ダウンチューブ

stem
potence
attacco
Lenkervorbau
potencia
ステム

handlebars
guidon
manubrio
Lenkstange
manillar
ハンドルバー

brake cable—outer
gaine
guaina
Bremszug-Hülle
funda de freno
ブレーキケーブルーアウター

brake cable—inner
câble de frein
cavo del freno
Bremszug
cable de freno
ブレーキケーブルーインナー

brake lever
poignée de frein
leva freni
Bremshebel
maneta de freno
ブレーキレバー

head tube
tube de direction
tubo sterzo
Rahmensteuerrohr
tubo de dirección
ヘッドチューブ

headset
jeu de direction
serie sterzo
Steuersatz
juego de dirección
ヘッド小物

front brake
frein avant
freno anteriore
Vorderbremse
freno delantero
前ブレーキ

fork crown
tête de fourche
testa forcella
Gabelkrone
amarre de tijera
ホーク肩

fork
fourche
forcella
Vordergabel
horquilla
ホーク

wheel
roue
ruota
Rad
rueda
車輪

fork tip
patte avant
punta forcella
vorderes Ausfallende
puntera de horquilla
前ホークツメ

inner tube
chambre à air
camera d'aria
Schlauch
camera
チューブ

hub
moyeu
mozzo
Nabe
buje
ハブ

tire (GB–tyre)
pneu
pneumatico
Reifen
neumático
タイヤ

gear lever
manette de dérailleur
leva del cambio
Schalthebel
maneta del cambio
変速レバー

rim
jante
cerchio
Felge
llanta
リム

spoke
rayon
raggio
Speiche
radio
スポーク

quick release
blocage rapide
bloccaggio rapido
Schnellspanner
cierre rapido
クイックリリーズ

* APPENDIX

CONVERSION CHART

Millimeters to Inches

1mm = 0.0394 inches

1 inch = 25.4 millimeters

Millimeter	Dec. Equiv.	Fractional
.1	.0039	
.2	.0079	
.25	.0098	
.3	.0118	
.39	.0156	1/64
.4	.0157	
.5	.0197	
.6	.0236	
.7	.0275	
.75	.0295	
.79	.0312	1/32
.8	.0315	
.9	.0354	
1.0	.0394	
1.1	.0433	
1.19	.0469	3/64
1.2	.0472	
1.25	.0492	
1.3	.0512	
1.4	.0551	
1.5	.0591	
1.59	.0625	1/16
1.6	.0630	
1.7	.0669	
1.75	.0689	
1.8	.0709	
1.9	.0748	
1.98	.0781	5/64
2.0	.0787	
2.1	.0827	
2.2	.0866	
2.25	.0886	
2.3	.0905	
2.38	.0937	3/32
2.4	.0945	
2.5	.0984	
2.6	.1024	
2.7	.1063	
2.75	.1083	
2.78	.1094	7/64
2.8	.1102	
2.9	.1142	
3.0	.1181	
3.1	.1220	
3.18	.1250	1/8
3.2	.1260	
3.25	.1279	
3.3	.1299	
3.4	.1338	
3.5	.1378	
3.57	.1406	9/64
3.6	.1417	
3.7	.1457	
3.75	.1476	
3.8	.1496	
3.9	.1535	
3.97	.1562	5/32
4.0	.1575	
4.1	.1614	
4.2	.1654	
4.25	.1673	
4.3	.1693	
4.37	.1719	11/64
4.4	.1732	
4.5	.1772	
4.6	.1811	
4.7	.1850	
4.75	.1870	
4.76	.1875	3/16
4.8	.1890	
4.9	.1929	
5.0	.1968	
5.1	.2008	
5.16	.2031	13/64
5.2	.2047	
5.25	.2067	
5.3	.2087	
5.4	.2126	
5.5	.2165	
5.56	.2187	7/32
5.6	.2205	
5.7	.2244	
5.75	.2264	
5.8	.2283	
5.9	.2323	
5.95	.2344	15/64
6.0	.2362	
6.1	.2401	
6.2	.2441	
6.25	.2461	
6.3	.2480	
6.35	.2500	1/4
6.4	.2520	
6.5	.2559	
6.6	.2598	
6.7	.2638	
6.75	.2656	17/64
6.8	.2677	
6.9	.2716	
7.0	.2756	
7.1	.2795	
7.14	.2812	9/32
7.2	.2835	
7.25	.2854	
7.3	.2874	
7.4	.2913	
7.5	.2953	
7.54	.2969	19/64
7.6	.2992	
7.7	.3031	
7.75	.3051	
7.8	.3071	
7.9	.3110	
7.94	.3125	5/16
8.0	.3150	
8.1	.3189	
8.2	.3228	
8.25	.3248	
8.3	.3268	
8.33	.3281	21/64
8.4	.3307	
8.5	.3346	
8.6	.3386	
8.7	.3425	
8.73	.3437	11/32
8.75	.3445	
8.8	.3465	
8.9	.3504	
9.0	.3543	
9.1	.3583	

APPENDIX

Millimeter	Dec. Equiv.	Fractional
9.13	.3594	23/64
9.2	.3622	
9.25	.3641	
9.3	.3661	
9.4	.3701	
9.5	.3740	
9.53	.3750	3/8
9.6	.3780	
9.7	.3819	
9.75	.3838	
9.8	.3858	
9.9	.3898	
9.92	.3906	25/64
10.0	.3937	
10.32	.4062	13/32
10.5	.4134	
10.72	.4219	27/64
11.0	.4330	
11.11	.4375	7/16
11.5	.4528	
11.51	.4531	29/64
11.9	.4687	15/32
12.0	.4724	
12.30	.4843	31/64
12.5	.4921	
12.7	.5000	1/2
13.0	.5118	
13.10	.5156	33/64
13.49	.5312	17/32
13.5	.5315	
13.89	.5469	35/64
14.0	.5512	
14.29	.5625	9/16
14.5	.5709	
14.68	.5781	37/64
15.0	.5906	
15.08	.5937	19/32
15.48	.6094	39/64
15.5	.6102	
15.88	.6250	5/8
16.0	.6299	
16.27	.6406	41/64
16.5	.6496	
16.67	.6562	21/32
17.0	.6693	
17.06	.6719	43/64
17.46	.6875	11/16
17.5	.6890	
17.86	.7031	45/64
18.0	.7087	
18.26	.7187	23/32
18.5	.7283	
18.65	.7344	47/64
19.0	.7480	
19.05	.7500	3/4
19.45	.7656	49/64
19.5	.7677	
19.84	.7812	25/32
20.0	.7874	
20.24	.7969	51/64
20.5	.8071	
20.64	.8125	13/16
21.0	.8268	
21.03	.8281	53/64
21.15	.8327	
21.43	.8437	27/32
21.5	.8465	
21.6	.8504	
21.7	.8543	
21.83	.8594	55/64
21.85	.8602	
21.9	.8622	
22.0	.8661	
22.23	.8750	7/8
22.5	.8858	
22.62	.8906	57/64
23.0	.9055	
23.02	.9062	29/32
23.42	.9219	59/64
23.5	.9252	
23.81	.9375	15/16
24.0	.9449	
24.21	.9531	61/64
24.5	.9646	
24.6	.9687	31/32
25.0	.9843	
25.0	.9844	63/64
25.4	1.0000	1
25.6	1.0079	
25.8	1.0157	1-1/64
26	1.0236	
26.19	1.0312	1-1/32
26.2	1.0315	
26.4	1.0394	
26.5	1.0433	
26.59	1.0469	1-3/64
26.6	1.0472	
26.8	1.0551	
26.99	1.0625	1-1/16
27	1.0629	
27.2	1.0708	
27.38	1.0781	1-5/64
27.4	1.0787	
27.78	1.0937	1-3/32
28.18	1.1094	1-7/64
28.58	1.1250	1-1/8
28.97	1.1406	1-9/64
29.37	1.1562	1-5/32
29.77	1.1719	1-11/64
30.16	1.1875	1-3/16
30.2	1.1889	
30.56	1.2031	1-13/64
30.95	1.2187	1-7/32
31.35	1.2344	1-15/64
31.75	1.250	1-1/4
32	1.2598	
34.7	1.3661	
34.92	1.3750	1-3/8
35	1.3779	
36	1.4173	

For larger numbers, move decimals to the right:
e.g., 220 mm = 8.661 inches

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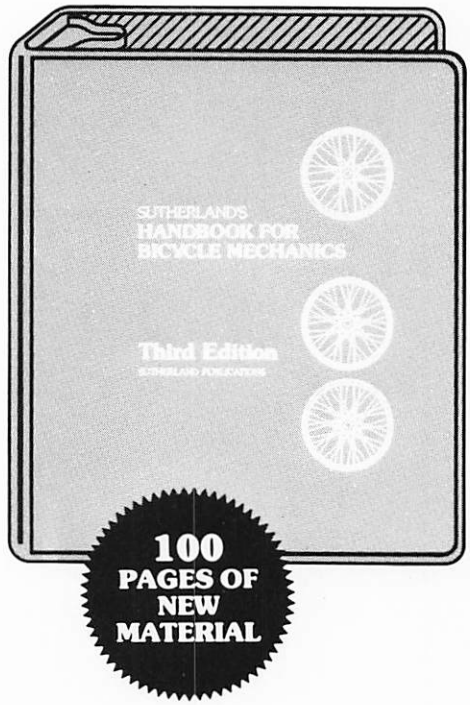
"The bike mechanic's bible"

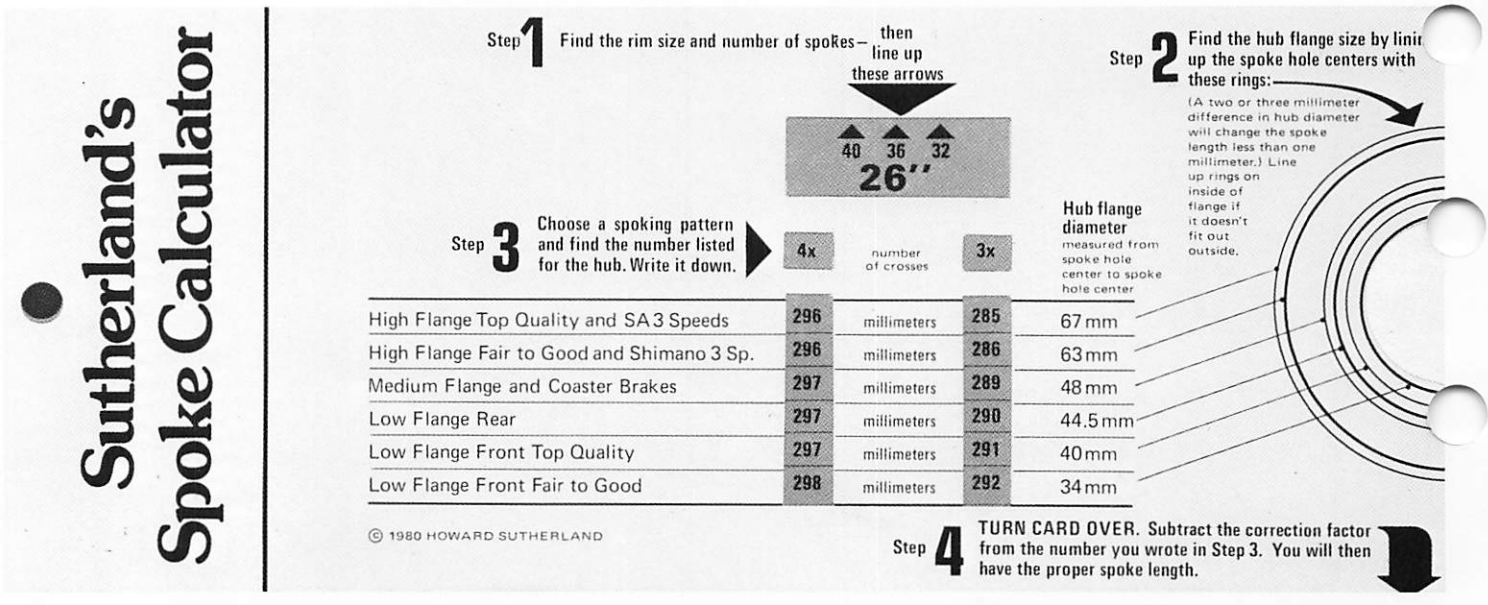
Typical comments from Handbook users: . . . *couldn't do without it—use it every day . . . has saved us countless hours . . . speeds up repairs—worth its weight in gold . . . yours is a beautifully well done reference manual . . .*

Easy to use, sensibly organized, large tabs to help you get to what you're looking for quickly. Easy to read large print, tables and tables of useful information, this Handbook is used every day by mechanics all over the country. Eliminate the guess work and time wasting trial and error in your shop. Suggestion: order one for each mechanic, and one for your order desk.



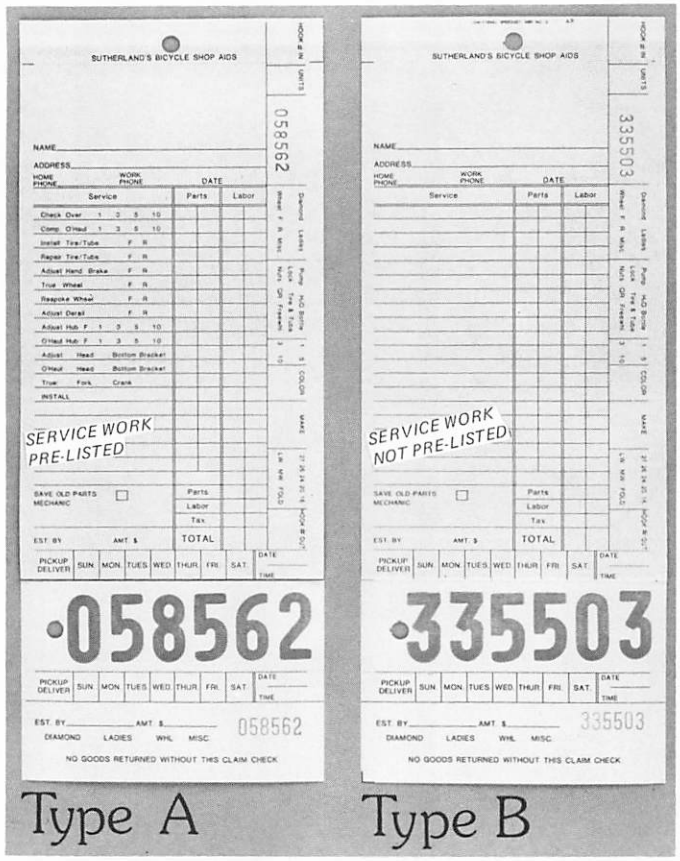
The Spoke Chart that Works

SHOP TESTED—Easy to use, with clear, simple instructions, this new and improved shop chart still • gives accurate lengths for over 1500 combinations of hubs and rims • Saves time and money by eliminating wasted labor • Gives exact spoke lengths for 90 widely used rims when used with any of six hub sizes • Has an easy conversion chart for changing millimeters to inches. Other features are: • An easy way to measure hubs • A list of rim dimensions • Time-saving spoke hole counter for rims • Hole provided to hang it up within easy reach


Sutherland's
Spoke Calculator
Step 1 Find the rim size and number of spokes— then line up these arrows
40 36 32
26''
Step 2 Find the hub flange size by linir up the spoke hole centers with these rings:
(A two or three millimeter difference in hub diameter will change the spoke length less than one millimeter.) Line up rings on inside of flange if it doesn't fit out outside.
Step 3 Choose a spoking pattern and find the number listed for the hub. Write it down.
4x
number of crosses
3x
Hub flange diameter measured from spoke hole center to spoke hole center
High Flange Top Quality and SA 3 Speeds 296 millimeters 285 67 mm
High Flange Fair to Good and Shimano 3 Sp. 296 millimeters 286 63 mm
Medium Flange and Coaster Brakes 297 millimeters 289 48 mm
Low Flange Rear 297 millimeters 290 44.5 mm
Low Flange Front Top Quality 297 millimeters 291 40 mm
Low Flange Front Fair to Good 298 millimeters 292 34 mm
© 1980 HOWARD SUTHERLAND
Step 4 TURN CARD OVER. Subtract the correction factor from the number you wrote in Step 3. You will then have the proper spoke length.

Repair tags

Available with or without your shop name imprinted



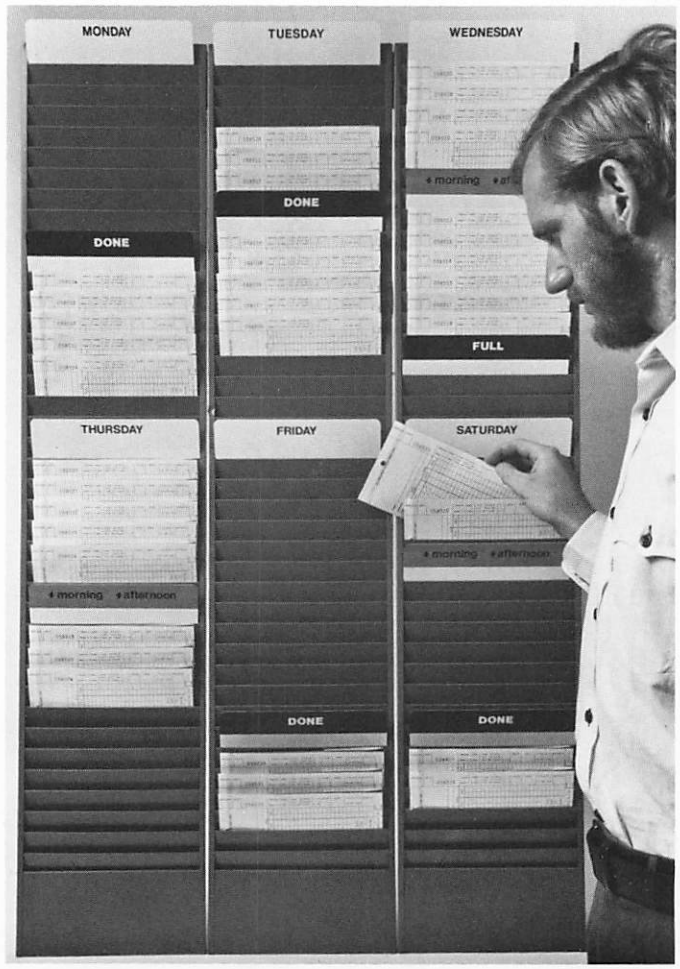
…at and efficient—saves time and money • Easy to fill out and …e. Just circle items. • Make work flow smoothly • Reduces customer complaints • Numbered claim check for customer • Big one-inch-high numbers on bike tag locate bikes quickly • Two complete copies of work done

Sutherland REPAIR TAGS make the work flow smoothly through your shop. New work is quickly "booked", saving on mechanic's expensive …or time. Accessories that are likely to come in on the bike are listed … this tag—you simply circle it. This way, a bike that comes in with a pump goes out with a pump.

Each tag includes the original and one copy. When the repair is finished you have two complete records of the work done; one for your customer and one for your file. The bottom copy is printed on heavy stock and includes a tear-off claim check and a tear-off job tag which can be attached to the bike with ordinary shower curtain hooks (not supplied). The large red numbers on the job tag can easily be seen across the room. Additional parts and labor can be listed on the back of the tag.

Keep your repair tag work orders all in one place. Use our special tag RACKS or simply hang them on a hook or nail. Group them together according to the way the work is to be finished. You'll be able to see your work load at a glance and avoid over-booking.

Racks for repair & inventory tags



Your work load at a glance • For most efficient work load scheduling • Prevents under- and over-booking of repairs and new bike set-ups • Handy dividers keep work organized • Locate customer tags quickly

…r efficient service management, use Sutherland REPAIR TAG RACKS …o hold and organize your repair tags and inventory tags. Tags are inserted horizontally with numbers showing in the 40-slot rack. Heavy-duty varnished DIVIDER CARDS (sold separately) aid in grouping the tags according to the day the work is to be done. These cards are printed in bold easy to read letters. Each set contains seven day cards (SUNDAY, MONDAY, TUESDAY, etc.), seven DONE cards, seven FULL …rds, and seven, MORNING/AFTERNOON cards. 4¼" X 7¾" long, the …ards fit into the same slots as the repair tags.

For repairs: When a customer comes in for his bike you can put your hand on the right tag quickly, tell how much the repairs cost and then go get the bike while they write their check.

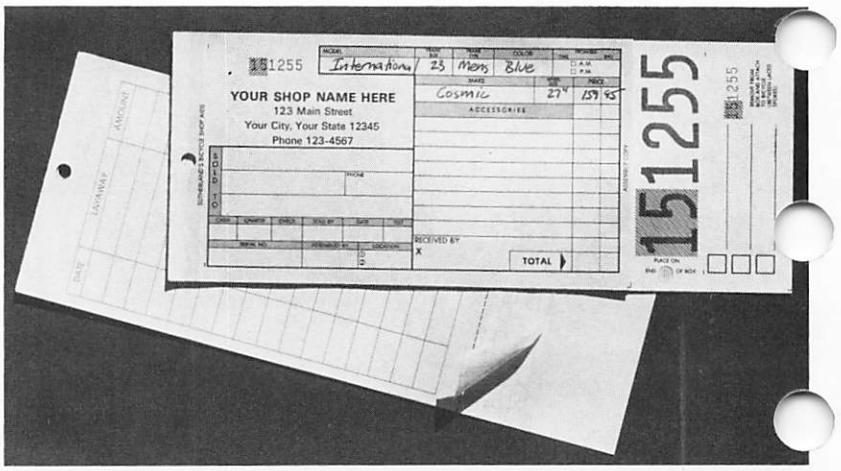
For new bike set ups: Pull the inventory tag for the bike to be set up …nd put it in the rack along with the repair tags.

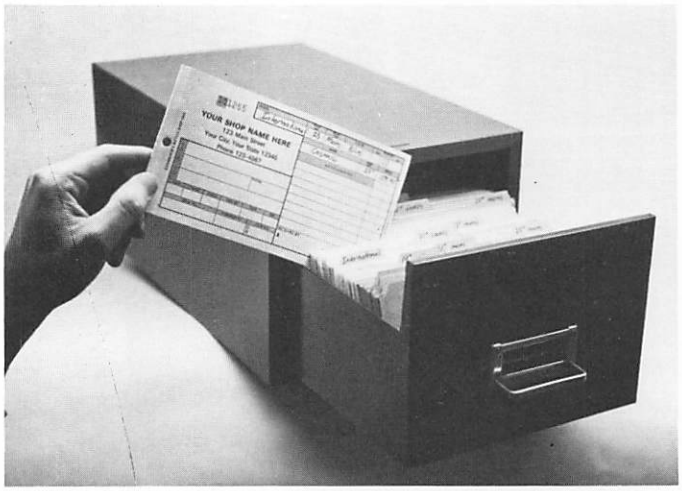
…hen you've promised all the work you can for any day, put in the FULL sign. During the busy summer season it's easier to point to that FULL sign than try to explain why you can't take on more work for that day.

These sturdy grey painted steel racks will last a lifetime. Outside dimensions: height 44", width 9", depth 1 1/16". Pocket dimensions: height 2 7/16", width 8 5/16", depth 3/8" Shipping weight is 12¾ pounds.

Bicycle Inventory Sales Forms

- FAST—when sale is made form is already filled out—just fill in customer name and address and total.
- SIMPLE—white copy showing indicates bike is in box, yellow copy showing indicates its assembled, pink copy showing means its sold.
- EASY—Put bike boxes directly into storage. Boxes that are already inventoried have big 1" self-adhesive number attached. Boxes without number need to be inventoried.
- Bottom tear-off stub attaches to bike when assembled for positive identification. Space to write in status of bike.
- Fits in Repair Tag rack for planning set ups and repairs—make the best use of mechanics labor time.
- Lay-away payment record on back.
- If this system saves you one (1) minute per bike (I think it will save much more) say you sell 600 bikes, that's 600 minutes or 10 hrs. If your shop rate is $10.00/hour that's $100.00 saved!!





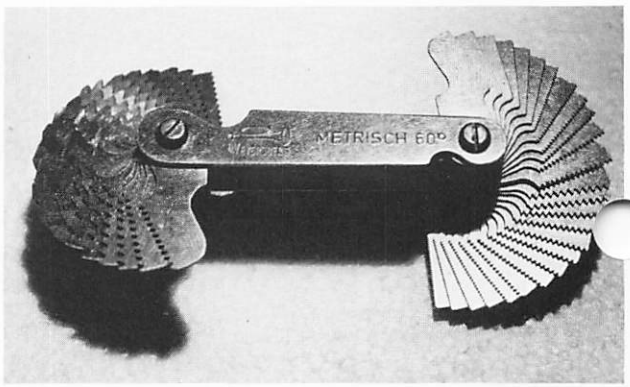
File Cabinets

• nylon guide for smooth operation • will hold about 450 completed forms • outside dimensions—7 3/16" H × 9 1/2" W × 16" D • convenient and good looking file for storing inventory tags • your bike inventory at your finger tips • your model mix at a glance • simplifies ordering new bikes

File Guides

• Arrange your inventory tags by model and frame size • Simply write in model and size • Made of card stock for long use • Just the right size for your inventory forms • 100 to box

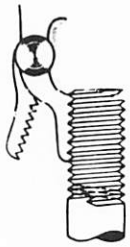
Metric-Whitworth Thread Gauge



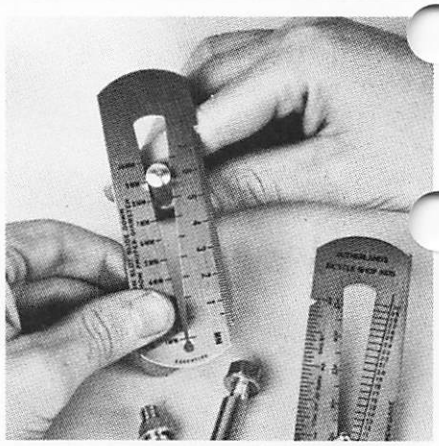
52 blade Metric and Whitworth—also works on most American threads. Includes 26 TPI found on Raleighs.

What thread is that screw or nut? With a thread pitch gauge, the answer's easy Merely select the blade that fits against thread and read threads per inch stamped on blade. Eliminates costly, frustrating ruined threads due to misfits, wrong guesses.

Gauges are all steel, for lifetime use. Each precision blade is marked, lockable in position, and measures internal and external threads.



Small diameter gauge



Quick and easy measurement of any diameter, from one to ten mm (1/16" to 7/16") • Measure crank cotters, hub axles, ball bearings, bolts—you name it • Simply insert item into slot and read-off diameter • Combination inches and metric scales • Save wear and tear on your expensive vernier calipers.

Dear People

I have a suggestion that will improve your book. _____

_____

_____

Here is some technical information you will be interested in _____

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My source for this information is _____

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